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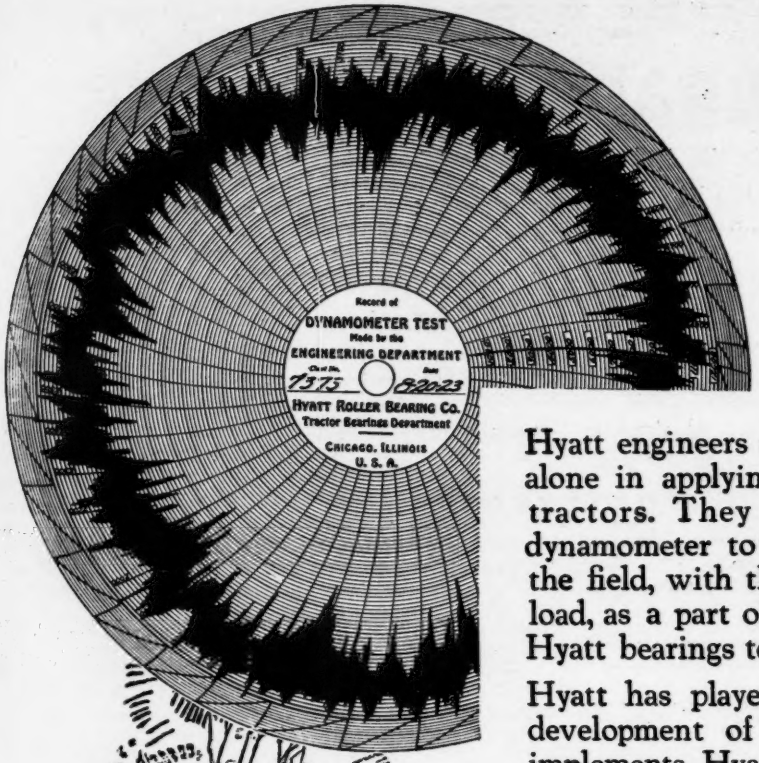
The Object and Scope of A. S. A. E. Activities

THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
(b) Farm Structures—buildings and other structures and related equipment.
(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.



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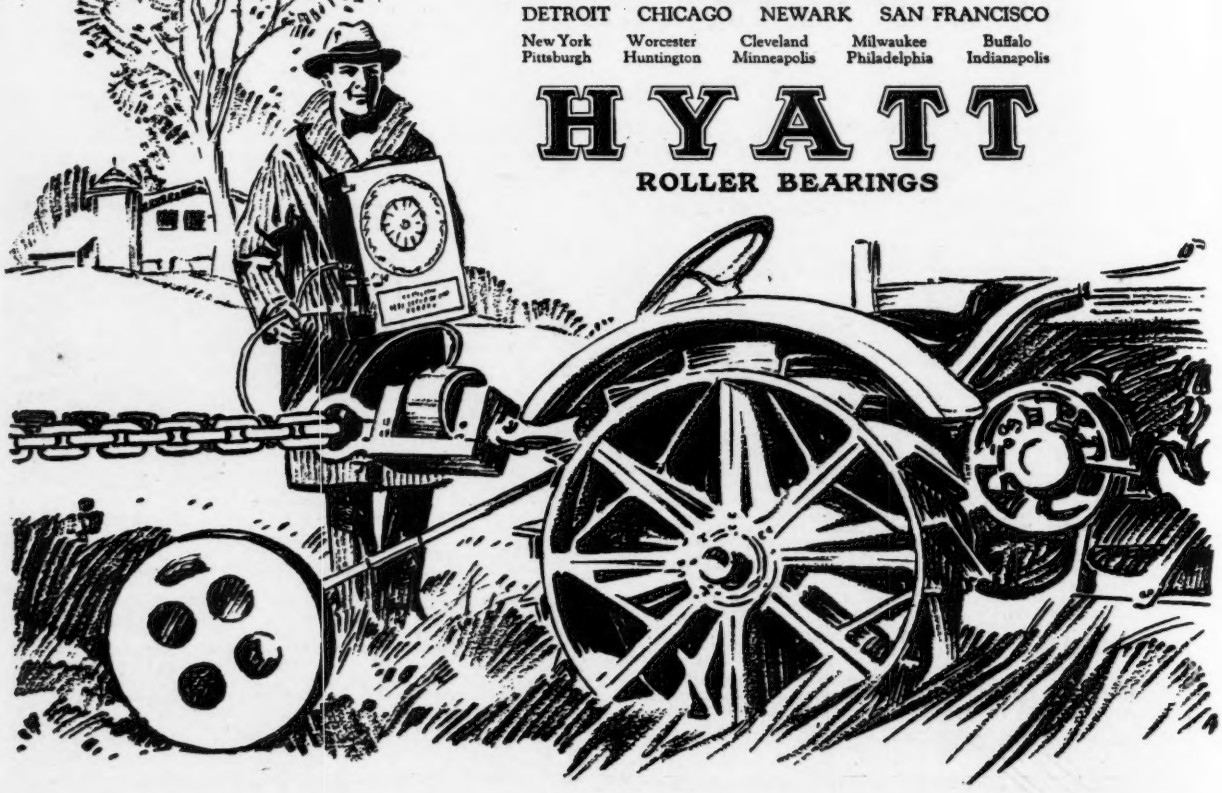

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Vol. 5 MARCH, 1924 No. 3

Some Power Studies Through Use of the Ohio Recording Belt Dynamometer*

By G. W. McCuen

Mem. A. S. A. E. Professor of Agricultural Engineering, Ohio State University

DURING the 1920 tractor tests at Ohio State University a farmer asked: "Why don't you build a dynamometer that will give us a picture of the power requirements and performance of belt-driven machines?" This interest on the part of a prominent Ohio farmer resulted in the opportunity long sought for by the agricultural engineering staff, to build a dynamometer in which the prime mover, in a cradle, would swing to make possible the recording of a torque due to resistance in a belt. The design of such a unit was completed in 1920 but lack of funds delayed its construction until 1922.

After a series of preliminary runs and calibration tests in the spring of 1923, the Ohio belt dynamometer was used in actual farm work. The duration of these tests has not been sufficient to render the results conclusive and no claim is made for them on that basis. The studies, however, are interesting; they are valuable for the tendencies shown, for their suggestion of the pertinent facts to be scientifically investigated, and the experience gained from these tests will prove invaluable in future work. Thus these studies are presented at this time, first, to evoke discussion as to methods and possibilities; second, to present some interesting data thus far obtained, and third, to encourage the building of machines for like duty at other institutions so that the investigation of power requirements and of performance of belt machines may be carried on in a more extensive way affording opportunity for collaboration.

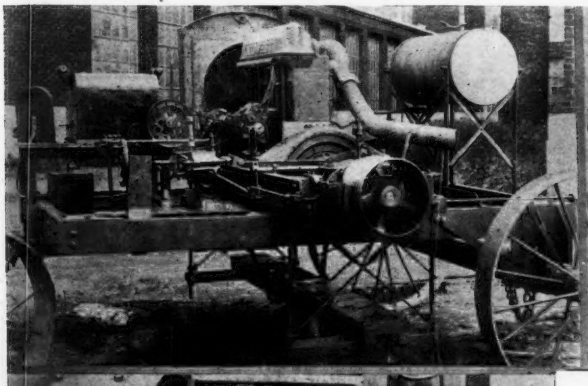
*Paper presented at the 17th annual meeting of the American Society of Agricultural Engineers, Chicago, November, 1923.

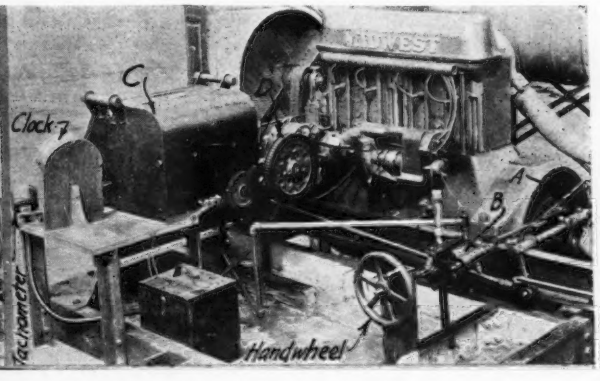
Description of the Dynamometer

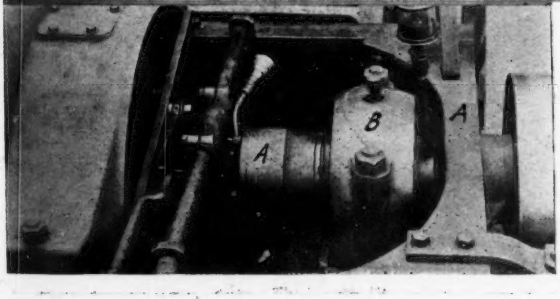
The Ohio recording belt dynamometer uses a 4½x6 Midwest engine, fully equipped, mounted in a 5-inch, 11-pound channel iron frame with cast trunnion ends, A. These trunnions (right hand), shown in Fig. 1, are mounted on large ball bearings, B, giving the frame a very free turning movement. The 1½-inch chrome nickel drive shaft passes through the center of the trunnions and is also mounted on roller bearings. Fiber washers take care of the shaft flotation, one being placed between the belt pulley and outboard bearing cap and the other between the inboard bearing cap and the disk clutch.

The counter weight arrangement, shown in Fig. 2, is used to bring the center of gravity of the cradle and its load to the center of the crankshaft so that no factors, except torque forces due to belt resistance, shall be effective in causing the motor to rotate, or in preventing its tendency to rotate, about the crankshaft. There is approximately 450 pounds of cast iron and channel iron in the counter weight arrangement, and the motor is thus perfectly balanced in any position within the working limits which are 1⅛-inches on each side of the vertical plane.

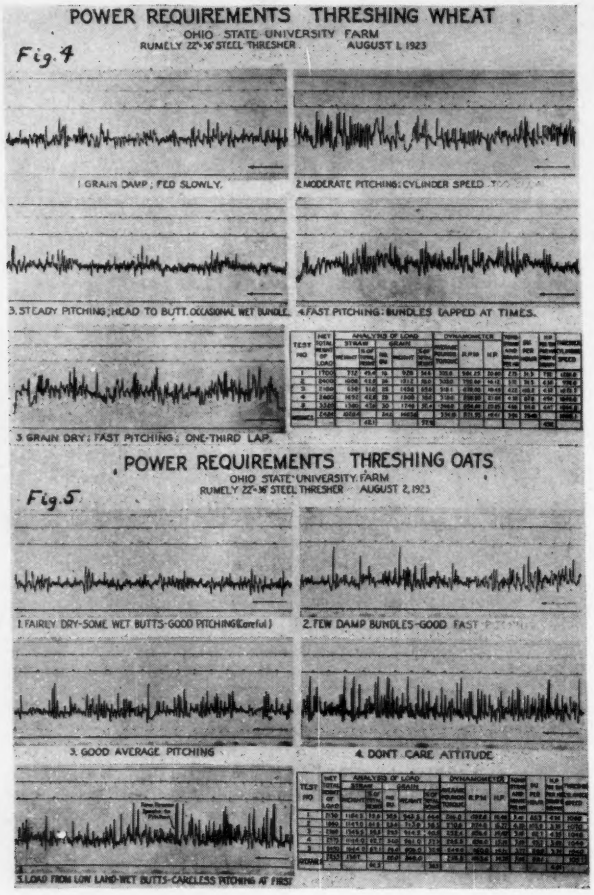
The point at which the torque is measured is 4.21 inches







THE OHIO RECORDING BELT DYNAMOMETER
Fig 1. (left) shows some of the details of the engine mounting. Fig. 2 (upper left) shows the counter weight arrangement used to bring the center of gravity of the cradle and its load to the center of the crankshaft. Fig. 3 (upper right) is a close-up view showing the general arrangement and construction of the Ohio dynamometer.


POWER REQUIREMENTS THRESHING WHEAT
OHIO STATE UNIVERSITY FARM
RUMELY 22"-36" STEEL THRESHER AUGUST 1, 1923
Fig. 4
1. GRAIN DAMP; FED SLOWLY.
2. MODERATE PITCHING; CYLINDER SPEED
3. STEADY PITCHING; HEAD TO BUTT. OCCASIONAL WET BUNDLE.
4. FAST PITCHING; BUNDLES TAPPED AT TIMES.
3. GRAIN DRY; FAST PITCHING; ONE-THIRD LAP.
POWER REQUIREMENTS THRESHING OATS
OHIO STATE UNIVERSITY FARM
RUMELY 22"-36" STEEL THRESHER AUGUST 2, 1923
Fig. 5
1. FAIRLY DRY-SOME WET BUTTS-GOOD PITCHING(certain)
2. FEW DAMP BUNDLES-GOOD FAST
3. GOOD AVERAGE PITCHING
4. DONT CARE ATTITUDE
5. LOAD FROM LOW LAND-WET BUTTS-CARELESS PITCHING AT FIRST

above the center of the crankshaft. The torque arm brace, A, Fig. 3, is attached to the bell housing of the engine so that the torque is transmitted directly from the engine to the hydrostatic coupling, B, which transmits the oil pressure to the indicator cylinder of the recording device. The recording device and coupling are the typical units of the Gulley traction dynamometer, manufactured by Burr & Company, Champaign, Illinois. A slight leakage of oil will allow the engine to approach its maximum stop; to compensate for this, an adjustment by the hand wheel, shown in Fig. 3, is used to draw the cylinder of the coupling back until the engine is riding properly between its limits. When the motor is developing 25 to 30 horsepower, this correction must be made about every half hour, a telltale warning the operator if the adjustment is neglected.

The recording device, C, shown in Fig. 3, is driven directly from the pump shaft by a link belt and train of gears, D, the speed ratio being such that the paper in the recording device travels 1 inch for each 1000 r. p. m. of the engine. As the time is automatically recorded on the paper, it is an easy matter to calculate the average speed the engine has made during any test; the speed of the engine at any instant is read from a tachometer.

The indicator in the recording device is a regular steam engine indicator adapted to this purpose. Different scale springs for different loads can be used to increase or decrease the range of fluctuation of any load as the case may demand. The exact area of the hydrostatic coupling is 2 square inches, that of the indicator piston is ½ square inch, giving a ratio of 1 to 4 between the two. Thus, every inch of mean average height of curve represents a torque equal to four times the scale of the spring used. For example, if a 50-pound scale spring is used and the mean average height of curve is one inch, it is known that a 200-pound torque existed. With the torque arm equal to 4.21 inches (1-15 of 5.252 feet) the horsepower formula used with this dynamometer becomes $Hp. = WN \div 15{,}000$, in which W equals the force exerted at the torque arm connection and N equals the r. p. m. of the engine.

The dynamometer was calibrated with a pony brake, which had been previously calibrated against a Diehl electric dynamometer. It was found in this calibration that approximately the same loss in power existed between the brake and dynamometer that existed between the brake and electric dynamometer. The calibration curve established by this calibration is a straight line curve making an angle of 44 degrees and 50 minutes with the abscissa representing horsepower at the dynamometer. With this calibration data as a criterion the data obtained this past season in testing different belt-driven machines may be assumed reasonably accurate. The data in all cases are based on the horsepower delivered by the dynamometer.

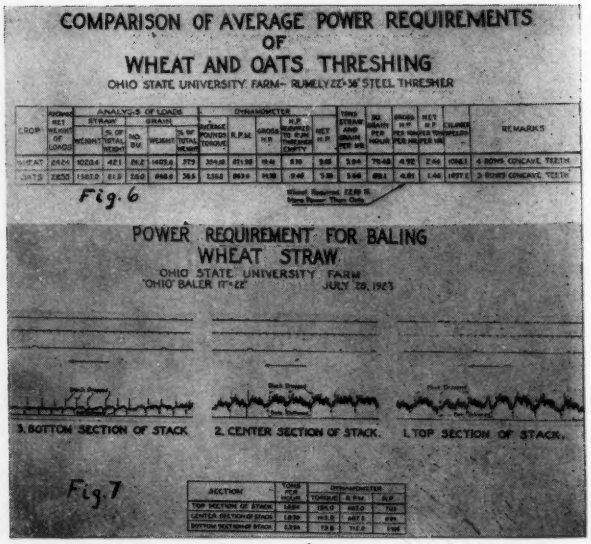
Studies In Threshing

Conditions during the past summer did not permit as extensive work on threshers and balers as was possible on ensilage cutters. However, the preliminary work on the former reveals some interesting data for discussion.

In cooperation with the university farm, the department of agricultural engineering threshed wheat and oats, using the farm's new Rumely 22x36 steel thresher. This thresher had been broken previously on about 15 acres of wheat and was nicely limbered up before the tests were started. Four rows of concave teeth were used.

Fig. 4 shows a series of curves obtained with this Rumely threshing Fulton wheat yielding 32 bushels to the acre. The first load was quite damp, but the rest of the material used in these tests was in good threshing condition except for an occasional wet bundle. In Test 1 the pitcher was instructed to pitch slowly; his small load of 1700 pounds was pitched off at the rate of 2.73 tons per hour and he left a space of about one-half bundle length between bundles. The cylinder was running at a speed too high for good threshing, and this, together with the damp grain condition, caused a horsepower consumption too high for the volume of material fed. The rest of the loads were fed at normal rate.

Comparing Tests 3 and 4 it is to be noted that good pitching has quite a definite influence on power consumption. Although the caption for Test 4 indicates fast pitching, the rate of pitching was practically the same as for Test 3, there being a difference of only 0.16 tons per hour, or Pitcher No. 4 pitched 3.79 per cent faster than No. 3. But the latter used care to place the bundles on the feeder, heads to butts, while the other fellow "just pitched." This careless pitching caused the thresher to consume 3.19


COMPARISON OF AVERAGE POWER REQUIREMENTS
OF
WHEAT AND OATS THRESHING
OHIO STATE UNIVERSITY FARM- RUMELY 22"-36" STEEL THRESHER
Fig. 6
POWER REQUIREMENT FOR BALING
WHEAT STRAW
OHIO STATE UNIVERSITY FARM
"OHIO" BALER 17"x22" JULY 28, 1923
3. BOTTOM SECTION OF STACK.
2. CENTER SECTION OF STACK.
1. TOP SECTION OF STACK.
Fig. 7

horsepower, or 19.3 per cent more power than the steady pitching in Test 3. Following Test 4, no record was kept until late in the afternoon when Pitcher No. 4 appeared again, this time with grain which had been turned out and was thoroughly dry. Test 5 is the record of this load. Comparing its curve with that of Test 4 the horsepower consumption was 4.7 per cent less than Test 4, although the rate of pitching was faster. The condition of the grain caused the difference.

The 1923 oat season was anything but ideal for good threshing. A badly lodged, rank growth of straw made it impossible to bind well-shaped bundles or to shock the grain to shed the heavy, frequent rains which followed cutting. It would have taxed any machine to the limit to handle this material in a highly satisfactory manner, and although the data secured under these conditions do not represent typical performance of a thresher, nevertheless they are secured under the actual field conditions with which a farmer or thresherman must contend occasionally.

The yield of the oats threshed was only 26 bushels per acre. Fig. 5 shows that the oats curves are very similar to those for wheat, but of course the mean average height of curve for oats is less.

The table in Fig. 6 compares the averages secured from wheat and oat threshing. It is interesting to note under the analysis of loads that in the case of wheat the greater percentage of the load by weight was grain; in the case of oats the greater part of the weight of the load was made up of straw. Although the oat yield was light, this analysis of loads tends to confirm the generally known fact that wheat threshing consumes more power than oat threshing. It was found that the empty thresher required 9.76 horsepower at normal speed when set for wheat, and 9.40 horsepower when set for oats. This difference of 0.36 horsepower may have been caused by such factors as tighter belts on thresher and tighter main belt when wheat was threshed, it being difficult to keep these factors constant in field operation.

As shown in the table in Fig. 6, wheat threshing consumed 4.63 horsepower, or 22.69 per cent, more power than oats. In making this comparison, however, it must be remembered that the figures were based on a fairly good wheat yield and a poor oat yield, the wheat yielding 32 bushels and the oats 26 bushels per acre.

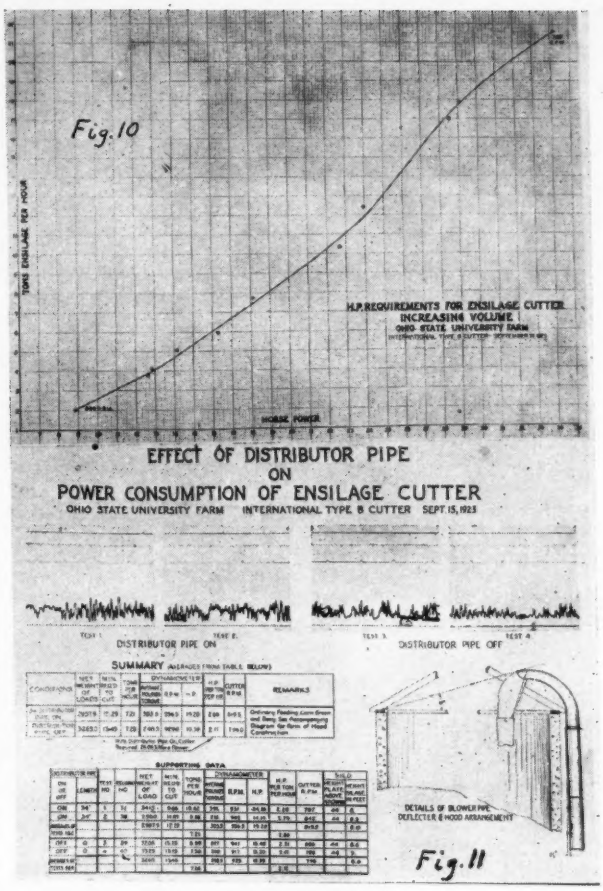
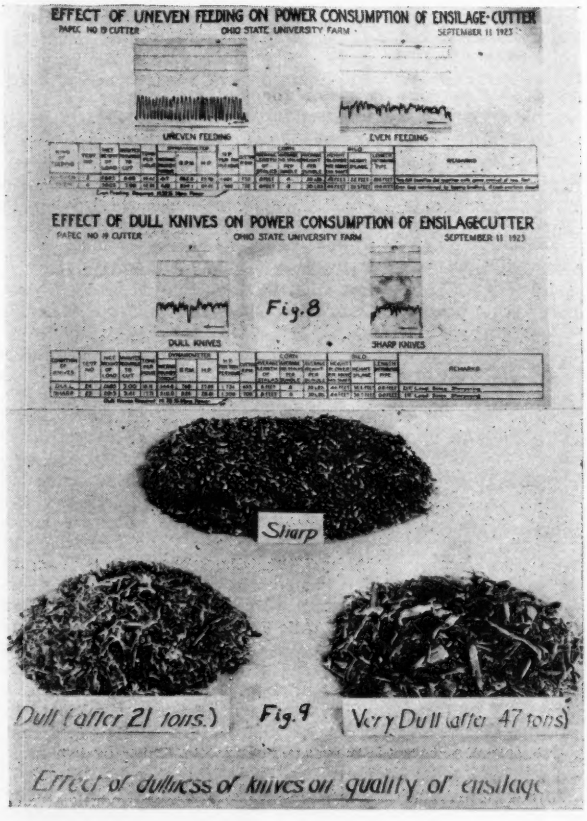


Fig.10
H.P. REQUIREMENTS FOR ENSILAGE CUTTER INCREASING VOLUME
OHIO STATE UNIVERSITY FARM
EFFECT OF DISTRIBUTOR PIPE ON POWER CONSUMPTION OF ENSILAGE CUTTER
OHIO STATE UNIVERSITY FARM INTERNATIONAL TYPE B CUTTER SEPT 15, 1923
DISTRIBUTOR PIPE ON
DISTRIBUTOR PIPE OFF
SUMMARY
SUPPORTING DATA
DETAILS OF BLOWER PIPE DEFLECTER & HOOD ARRANGEMENT
Fig.11

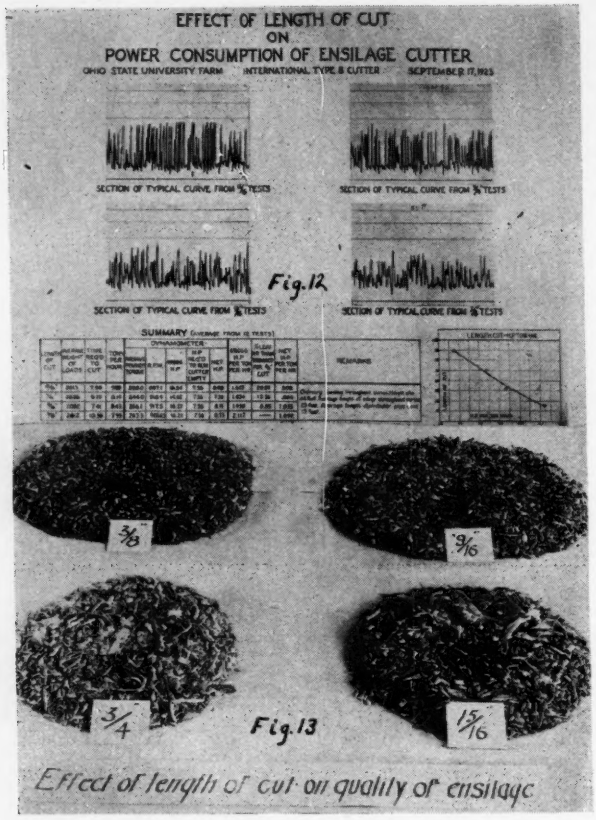


Studies In Baling Straw

The custom of the university farm to bale straw soon after threshing afforded opportunity to use the dynamometer in baling. An Ohio baler, size 17x22, was used, and as this was only the second season for this machine it was in a very good mechanical condition. No attempt had been made to stack the straw when it was threshed; the blower had been elevated, the hood tied back and the straw allowed to pile up. As one end of the stack had been baled the previous afternoon by another source of power, the dynamometer was used to bale a section in the center of the stack extending the entire height.

Fig. 7 shows three sections of curves obtained while baling three different portions of the center section of stack. Section 1 is data obtained when baling the top of the stack. The material was coarse and loose, requiring considerable compressing before it was baled. Large forksfull were easily fed into the chamber. Section 2 of the curve was obtained when presing straw from about the middle of the stack. The material was more compressed due to the pressure within the stack itself. This straw was not so easily handled and an additional pitcher was used in order to keep the feeding table well supplied with straw. Section 3 of the curve was obtained when pressing material from the bottom third of the stack which consisted mostly of short straw and some chaff in a rather compact mass. This material was handled easily with barley forks.

Note that the horsepower consumption became less as the bottom of the stack was approached. In other words, the horsepower requirement becomes less as the density of the material to be compressed increases. The mechan-


EFFECT OF LENGTH OF CUT
ON
POWER CONSUMPTION OF ENSILAGE CUTTER
OHIO STATE UNIVERSITY FARM INTERNATIONAL TYPE B CUTTER SEPTEMBER 17, 1925
SECTION OF TYPICAL CURVE FROM TESTS
SECTION OF TYPICAL CURVE FROM TESTS
Fig. 12
SECTION OF TYPICAL CURVE FROM TESTS
SECTION OF TYPICAL CURVE FROM TESTS
SUMMARY
3/8
9/16
3/4
15/16
Fig. 13
Effect of length of cut on quality of ensilage

ics of the baling process prove interesting. It is assumed that the resistance to the plunger of the baler is caused by the friction of the compressed straw on the side rails, and that the coarser the straw the greater the resistance. This would partially explain the lesser power required for the chaffy material; yet the size and weight of the bales composed of chaffy stuff were comparatively the same as those for the coarse straw bales; this, again, is probably due to the greater density of the chaffy material. In this connection it should be noted that investigations of both threshers and balers are hampered by the lack of a method of measuring density of such material as hay, straw and unthreshed grain; the weight basis for comparison is no longer sufficient.

Again referring to Fig. 7, the picture of the power consumption of a complete bale proves interesting. The code marks in the top line of the curves indicate when blocks were dropped and when bales were delivered; the arrows indicate the direction of travel of the paper. It will be seen that when the block is dropped the curve normally is in descendency and continues thus until the bale is completely discharged; the curve then immediately ascends until the bale is about one-half completed; from that point it continues in about the same plane until the block is dropped when it again begins its descent. The only reason that can be given for such performance is that, as soon as the tied bale is discharged, the new bale starts through the compression end of the chamber where the tension on it is greater than at previous points.

Although hay balers are considered rather simple machines, they may prove very interesting ones to investigate further. An exhaustive study may be of considerable value to both designer and user.

The dynamometer was used to drive a Papec No. 19 and an International Type B ensilage cutter, filling two different silos of the same size. No attempt was made to compare the two machines because they were run under slightly different conditions and in different series of tests. From this work data were secured on the effect of dull knives, length of cut, distributor pipe, and volume of ensilage on power consumption.

It has been generally believed by cutter operators that even feeding requires less power than uneven feeding. Actual findings in the field, however, tend to upset this theory as the data in the upper half of Fig. 8 show, the even feeding requiring 14.5 per cent more power. This is hard to explain. In studying the matter it must be noted that while even feeding gave an even, average torque with comparatively little fluctuation in r. p .m., uneven feeding gave wide fluctuations in both torque and r. p. m. During the uneven feeding test the tachometer attached to the engine showed a speed variation of from 625 to 1050 r. p. m., the governor opening up when the sudden load came on and before it could react the speed had been built up in excess of the regular setting. It can be noticed on the curve that the cutter was running nearly empty between bundles in the uneven feeding test; this may in part explain the lesser power consumption of this type of feeding. Although these data seem to favor uneven feeding, no competent operator would resort to such erratic feeding if he realized the severity of the strains observed in both cutter and prime mover.

The Effect of the Sharpness of Knives Was One of the Features of a Series of Tests

In the series of tests on sharp and dull knives, the results of which are shown in the lower half of Fig. 8, no attempt was made to regulate the rate of feeding. In other words, the teamsters enjoyed a spell of just plain, ordinary silo filling without frills attached and without interference from the college "profs." New, factory ground knives were used in Test No. 25. After twenty-one loads were cut inspection showed the knives quite dull, and Test 24 was then started. The results show that the dull knives required 14.78 per cent more power.

To show the effect of sharpness of knives on quality of ensilage Fig. 9 is exhibited. The remarks on the figure are self-explanatory—the material secured with sharp knives is ensilage, that with very dull knives is shredded green fodder. It has been recommended to the university farm by the agricultural engineering department that knives hereafter be changed four times a day, as it has been found that the time consumed in changing knives is several times compensated for by the better quality of ensilage and its effect upon keeping.

While making these tests the question arose as to just what is meant by the terms "sharp," "dull," and "very dull." Search for a standard revealed a means now existing for measuring the sharpness of small cutting instruments, but as this method hardly seems practical for large knives the matter is still subject for future investigation. The agricultural engineering staff is now working on this problem, with the aid of the Bureau of Standards, because is seems very likely that some such standard should be set before the proper collaboration between state institutions can be enjoyed.

Believing that a curve showing the relation between volume per hour and horsepower requirements would reveal some pertinent facts, a series of tests was conducted starting with a rate of feeding of two tons per hour and gradually increasing the volume until loads were being consumed at the rate of about 21 tons per hour. In order to minimize the effect of the knives dulling with each succeeding load, sharp knives were then inserted and the series reversed; starting with the 21 tons per hour volume, the same number of loads were cut until the two tons per hour volume was again reached. Fig. 10 shows the curve derived from these tests, each point representing the average of the loads nearest that volume. It is to be noticed that for volumes below 12 tons and above 18 tons per hour the horsepower increases faster than the volume, and that only between 12 and 18 tons per hour does the volume increase faster than the hoursepower. The rating of the International cutter, on which these tests were run, is listed as from 12 to 16 tons per hour. It is interesting to find that the tests indicate this range as being optimum for the most efficient use of the cutter.

Another factor—that of the capacity of the human being

—enters into this efficiency study. The average normal rate of throwing bundles onto the feeding table is about 9 tons per hour. When 12 tons were wanted it required 2 men, and at the 21-ton rate it required three men working hard to accomplish the feat. Above 20 tons per hour it really becomes necessary to have the loads loaded from both ends so that four men working in pairs can unload from the center if the full volume is to be maintained.

If it is true that listed ratings of cutters indicate the optimum feeding rates for greater efficiency, then, considering that one man can handle only 9 tons per hour, it would seem that the farmer should favor the smaller sizes of machines because he is always face to face with the labor shortage during silo filling time.

A factor in this connection, but one on which we have no data, is the effect of height of silo on the feeding range. These tests were run on 44-foot silos. Will a 60-foot silo raise or lower the feeding range within which a certain size cutter can be fed for greatest efficiency?

That a cutter using a 34-foot distributor pipe consumes 26.06 per cent more power than when the pipe is left off is shown in Fig. 11. This might seem of sufficient importance to suggest leaving the pipe off. But it is hardly necessary to record the observations made within the silo when the pipe was not used; the silage was blown to the opposite wall, as it fell, the coarser material scattered more than the heavier ear particles, working conditions within the silo were almost unbearable, and the material could be neither evenly scattered nor well tramped, even though the number of men was increased. The extra power required by the distributor pipe is well spent, the ensilage being blown down the pipe with such force that little tramping is necessary; and of course the advantage of the pipe to insure even distribution is well known.

The dotted portion of the distributor pipe shown in Fig. 11 is the part removed for the "pipe off" test. It should be noted that with the hood off the silage was still deflected downward 11 degrees from the horizontal.

Fig. 12 shows the effect of length of cut on power consumption and attention is called to the column in the table which shows that cutting the stalks into 15-16 inch lengths requires 20.87 per cent less power than 3-8-inch silage. From the consistency of the curve shown, we may assume the rule that the power consumption is inversely proportional to the length of cut. This is the result to be expected because in the case of the shorter cuts more work must be performed in cutting more frequently.

Of course the rate of feeding increased rapidly with the length of cut, and in establishing the optimum feeding range, discussed in connection with Fig. 10, the length of cut must be considered. With a machine set to cut 15/16-inch lengths, one man cannot unload at the rate of 9 tons per hour without the cutter running empty through a much greater percentage of the time than when the machine is cutting 3/8-inch lengths. Again it is to be emphasized that it will be extremely interesting to know how the optimum feeding range shifts as some of these factors affecting it vary.

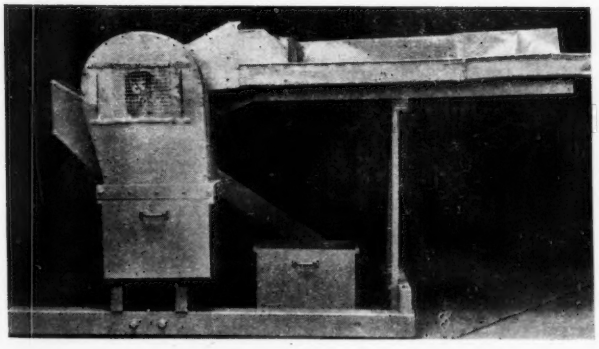
How the quality of silage is affected by the length of cut is shown in Fig. 13. Note the whole leaves in the 15/16-inch sample. Yet this sample is probably not as poor silage as the sample in Fig. 9, illustrating the effect of very dull knives.

The tests conducted thus far with the Ohio belt dynamometer have been looked upon by us as somewhat preliminary, preparatory to the more carefully outlined series which we hope to start at Ohio State University soon. We have profited greatly by the experience and will be glad to give others the benefit of our findings in regard to the control of the many factors influencing field work of this kind. We feel that our early theory is substantiated; that there are many pertinent things yet to be discovered about belt machinery. And we believe that a dynamometer of the type described is a very valuable asset in picturing and analyzing what actually takes place within the driven machines.

The California Miniature Thresher

A NEW machine designed and built by Hoffman, Zink and Winters, members of the agricultural engineering division of the University of California, seems to meet fully the need long felt by agricultural experiment stations for a really satisfactory means of threshing and separating the single bundle harvests of the rod-row experimental plots.

The California thresher is exceedingly simple, having only one shaft on which are carried the closed cast iron cylinder and a sheet metal blast fan. There are no other moving parts; no sieves, racks or riddles. Nevertheless practically perfect removal of the grain from the heads is secured and the separation of the grain from the straw and chaff is at least as good as the average accomplished by the large field machines.



The first model of the California miniature thresher and separator. A few changes are embodied in revised plans

Another feature is that, with ordinarily careful operation, there is absolutely no mixing of the grain, since the machine cleans itself automatically and without stopping between bundles

As all the working parts are of metal and designed of ample strength, there is no warping or cracking, and the cylinder can be speeded up as much as may be needed without danger of flying to pieces.

The machine is adjustable for grains of different kinds and threshing characteristics.

In the field a variable-speed, throttle-governed, four-horsepower gasoline engine was used, but only about one and one-half horsepower was required. A one-horsepower electric motor was used to thresh 1500 bundles in the laboratory. There was no undue heating of the motor. The cylinder speed was varied from about 800 to 1240 revolutions per minute, depending on the condition of the grain.

Three men were required, two to bring up the sheaves and to operate the machine and one to weigh and care for the threshed grain and to keep the record.

The illustration shows the machine in its first form. Use in the field indicated a few changes as desirable. These have been embodied in revised plans and specifications.

Begin laying your plans now to attend the biggest gathering of agricultural engineers in history—at Lincoln, Neb., June 17, 18, 19, 20, 1924

Electric Service for Rural Districts *

By G. C. Neff

Mem. A. S. A. E. General Manager, Wisconsin River Power Company

EXCEPT for the greater amount of distribution system necessary to serve the same number of rural customers, there is little difference between urban and rural electric service. The electricity supplied in either service is generated in the same way, usually in the same power house, transmitted over the same kind of lines, and delivered to similar homes for similar purposes.

A mile of urban distribution line ordinarily serves from thirty to one hundred customers, while a mile of rural line usually serves three customers. The new problems introduced by rural service are, therefore, largely caused either directly or indirectly by the unusually large amount of distribution system necessary for each customer served.

This condition would not present an unusual problem, if each farm customer used from five to ten times as many kilowatt-hours of electricity as is used by the average urban customer. At the present time, however, this is not the case, as the farmer customer uses on the average very little more than is used by the urban customer. It is therefore clearly evident that the kilowatt-hours sold from a mile of rural line under present conditions amount to about 10 per cent of the kilowatt-hours sold from a mile of urban line. If this energy is sold at urban rates, the revenue received per mile of rural line will be about 10 per cent of the revenue received per mile of urban line. A mile of rural line costs at least 50 per cent of the cost of a mile of urban line so that the ratio of revenue to distribution investment in rural business is only one-fifth as much as this same ratio in urban business. If the urban rates are properly designed and properly compensate the utility for all of its legitimate costs of supplying electric service to urban customers, it must be evident that these same rates will not give the utility proper compensation for supplying electric service to rural customers where for each dollar of income five times as many dollars must be spent for distribution lines.

It is therefore necessary under present conditions to make special rates for supplying electric service to rural districts. There have been about as many different methods used for supplying this service to farmers as there are companies to supply it.

In a number of cases farmers have organized utility companies and have purchased energy wholesale from central stations and distributed the energy over their own lines. This practice has the disadvantage of causing the farmers to go into a new business about which they know little. The result is that many mistakes are made which are often costly to the farmers themselves and in many cases the service supplied is inadequate.

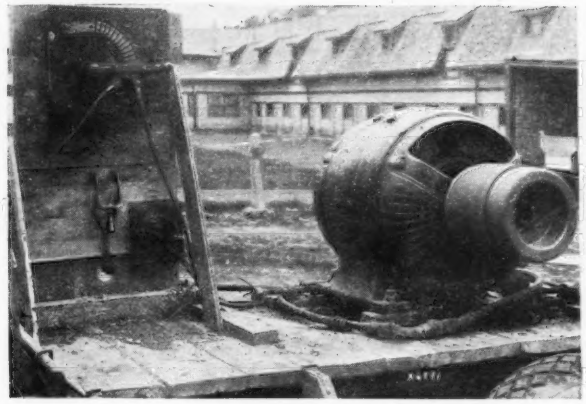
It is considered a much better plan to have the central station companies, that are in the business of generating and distributing electricity, serve the farmers individually. The accompanying table, which is taken from a report of the Rural Lines Committee of the National Electric Light Association, gives a brief analysis of different methods used in rural line development, where rural customers are served as individuals. This table shows two general methods of financing the distribution system as follows:

*Paper presented at the 17th annual meeting of the American Society of Agricultural Engineers, Chicago, November 1923.

Brief Analysis of Different Methods Used in Rural Line Development Where Rural Customers Are Served As Individuals

Plan No.	Financing	Ownership	Maintenance	RATES		
				Service Charge	Plus Energy Charge	
1	By the Customer Customers provide the money for entire construction of lines.	By the Utility Customers give title to utility without cost	By the Utility	Sufficient to cover amount by which maintenance, depreciation, taxes, operating costs and losses exceed the corresponding items in City Service allowance made for customer's investment	Regular Charge	This plan has the approval of the Wisconsin State Utilities Commission. Also recommended by Rural Lines Committees of Wisconsin, Nebraska Electrical Associations and Ohio Electric Light Association
2	Same as 1	By the Customer Utility to have option on its purchase	By the Utility Customers to be billed monthly for actual maintenance; also for liability insurance	Sufficient to cover operating costs and fixed charges on investment resting with utility giving consideration to customer's demand and transformer losses	Special primary rate with low excess rate	Plan used by some companies in Iowa and Illinois
3	By the Utility Either by sale to customers of its securities or from other sources	By the Utility	By the Utility	Same as 1, except an additional amount to provide a return on investment or the regular city rates throughout under a contract guaranteeing a minimum revenue per year sufficient to equal total investment in lines from 3 to 4 years	Regular City Rates	This plan is used only in comparatively densely populated territory
4	Jointly Utility-Customer Utility advancing an amount from 2 to 3 times amount of annual revenue the customers to provide the balance	By the Utility	By the Utility	Same as 3	.....	Same as 3
5	By the Utility	By the Utility	By the Utility	A calculated amount paid in one lump sum sufficient to make good the deficit which would otherwise be incurred by the utility by reason of the construction and operation of extension during the development period	Regular City Rates	Plan developed by Committee of the Northwest Geographic Division

THE chief obstacle to the more rapid extension of electric service to farm communities from central stations lies in the small amount of energy which the average farm consumes. The fewer kilowatt hours used, the more costly electrical energy becomes. The real economy is in using it for as large number of uses as possible. There is no question but that the farmer has great need for electricity for light and power. It would seem, therefore, that the agricultural engineer's job is to show him how to make greater and more economical use of it.



1. By the Customer. This plan has the advantage of causing a more rapid development of rural electric distribution systems. While the money is raised by the farmers and while the lines built with this money may be turned over to the utility, the utility has not the right to include in the cost of service, interest on any money which is donated by the farmer. In other words, the farmer receives interest on the money which he has spent for the building of the lines through a reduced monthly bill for service. If the utility supplies the money for the distribution system, the interest on this money must be paid by the farmer and the bill is increased by this amount.

2. By the Utility. If the financing is done in this way, the business is conducted along the same lines as in the city, where utility companies usually finance practically all extensions to their distribution systems. However, many utilities are not willing to spend such large amounts of money as are necessary to build rural electric distribution systems, largely because the use made of the systems by the farmer is so small that there is some question as to the economic soundness of supplying rural electric service from central station lines. In other words, rural electric service is in its early development stages; it has not become fully stabilized and is viewed by managers of many central stations as an uncertain business.

It is believed that, with increased use of electricity on the farm, the business will be looked upon with more favor by central station managers.

It will also be noted that there are three general types of rate structures:

1. Where the farmer pays regular urban rates plus a rural charge. The rural charge is really an excess cost charge which represents the difference in cost of serving a rural and urban consumer. This plan has been used by a number of utilities throughout the Middle West. This plan has the advantage of employing a rate structure which is in force, usually bears the approval of the utility commission, has been developed over a considerable period, is readily explained to customers and eliminates any question of discrimination between rural and city customers. This plan is very flexible and the rural service charge can vary to meet changing conditions. If there is any change in the cost of generation of electric current and the rates are adjusted in the city, the same adjustment is automatically made in the rural district.

When the farmer pays the excess or rural cost charge, he has then moved his farm to the city as far as electric service is concerned, and is entitled to all the rates and privileges of the urban customer.

2. Special service charge with a low rate for electricity. The service charge is sufficient in amount to cover all fixed charges and the energy rate is supposed to represent the actual cost of the energy. This has the advantage of making necessary only one meter per customer and also permits deviation from any existing unfair city rates and may be so arranged as to increase the use of service.

3. Special initial payment plan. In the northwestern part of the United States a plan has been developed whereby the farmer customer pays the company a calculated amount in one lump sum sufficient to make good the estimated deficit which would be incurred by the utility by reason of the construction and operation of the rural extension during the development period of that extension. This plan can be satisfactorily applied where the development period can be calculated with some degree of accuracy. It is not suitable where this cannot be done.

A proper application of any of the above plans gives results which are fair to both the farmer and the utility which serves him. All of these plans and combinations of them are in actual use in various parts of this country.

The United States Census for 1921 shows that there were 6,448,343 farms in the United States in that year, of which 452,620, or approximately 7 per cent, have either gas or electric service. It is estimated that approximately 5.4 per cent of these have electric service and 1.6 per cent gas service. Of these farms having electric service about one-half are supplied from central stations over transmission and distribution lines and the other half from individual and distribution lines and the other half from individual farm lighting plants. While a number of farms have been connected to central station lines since 1920, it will be noted that only a small percentage of the farms in this country have central station service. Where central station service is available, it is being used by the farmers in most cases for only a few of the many things for which it could be profitably used. The consumption of electrical energy is in most cases small. Due to this fact and to the large investment in distribution lines necessary to serve each farm the fixed charges and fixed operating costs of the average rural distribution systems are a very large percentage of the total cost of supplying rural electric service. If the consumption of electricity on the farm could be materially increased, it could in most cases be done with only a comparatively small increase in the fixed cost and, therefore, the utility would be able to sell a large amount of energy to the farmer at a very much reduced cost per kilowatt-hour than where only a small amount of energy is sold.

If the joint work between the agricultural and electrical interests which is now under way is successful in finding ways and means of profitably increasing the use of electric service on the farm, many of the perplexing problems which now exist will disappear. If this increased use could be made large enough so that the revenue received for the service would bear a ratio to the investment in necessary lines, etc., comparable with the same ratio in city and urban business, there would then be practically no difference between rural and urban business and utilities would then extend their lines into the country in the same way that they now extend them in the city.

Standardization of Rough Machine Bolts, Carriage Bolts, Nuts, Plow Bolts and Wrench Openings Used in Farm Equipment

By O. B. Zimmerman

THE meeting held in Washington, D. C. in the Department of Commerce, Division of Simplified Practice, on February 19 and 20, was attended by some fifty delegates and representatives of manufacturers, consumers, distributors and general interest organizations.

The principals and representatives may be grouped under the following heads:

American Society of Mechanical Engineers
Society of Automotive Engineers
American Society of Agricultural Engineers
American Society for Testing Materials
War Department
Navy Department
U. S. Bureau of Standards
Society of Naval Architects and Marine Engineers
National Association of Farm Equipment Manufacturers
National Machine Tool Builders Association
Bridge Builders and Structural Society
American Railway Association
American Electric Railway Association
Electric Power Club
American Boiler Manufacturers Association
The Railway Car Manufacturers Association
American Hardware Manufacturers Association
Master Boiler Makers Association
The Gas Engine and Farm Power Association
Associated Manufacturers of Electrical Supplies.

As this is a problem of vital economic interest and one in which it was possible for all delegates who had restricted views on several points to exchange ideas with those who were equally sure of their points of view, it is worthy of note that the conclusions should have been so satisfactory.

For more than two years work has been carried on in committees, hence it might be well to review briefly what some of the problems really were, inasmuch as the average person is inclined to view this problem as one of mediocrity.

The problem then was to cover rough bolts and nuts, with due regard to a minumum number of wrench openings which would fit as well standard finished hexagon and square nuts and bolt heads, cap screws, set screws and machine screws.

It was necessary to consider the question of standardizing all dimensions and form of these products, and then allowable variations or tolerance therefrom for practical manufacture and use over the range from ¼ to 3-inch body diameter.

The threads standards, as developed for the various diameters, shapes and tolerances for the several classes of fits were easily chosen, as this work was developed by the National Screw Threads Commission and the committees of the Society of Automotive Engineers and the American Society of Mechanical Engineers. The coarse thread free fit class was adopted as standard which class corresponds exactly to the medium fit of the earlier report of the Screw Threads Commission. This fit with the described methods of gauging was unanimously recommended.

The across face dimension of bolt heads and nuts, and thickness of heads and nuts covering thin nuts, standard and heavy nuts were settled in each case to conform to a general formula, varied only to meet the necessary changes for strength or to reduce the number of wrench openings required to meet the full line.

Plow bolt standards were thoroughly reviewed and the form types with their several recommended sizes and tolerances as presented by the committee of the National Association of Farm Equipment Manufacturers were unanimously adopted.

Recommended variations in length of standard bolts, the methods of designation of length and proportion of parts, chamfers, angles of head, etc., were among the items discussed and standardized.

It is clear that this thorough review means much to everyone concerned. Manufacturers have fewer types of dies and other equipment of standard requirements to keep on hand; they can manufacture greater numbers of one size with a certainty of disposal than heretofore; the dealer who carries a stock will be benefited in that his stock is reduced in variety, sizes, and variations, necessitating a smaller outlay in stock on hand; the user is insured of greater certainty of the fit of the several parts than heretofore, and has the assurance when once this stock is regularly available and in use, that his required number of wrenches will be less, and they will fit whereas now he either has to carry a large number of slightly varying openings, or has to use a wrench with too much freedom.

With the standardized wrench openings and supplies noted above he is sure of a higher grade product, a better fitting of parts, a certainty that his tightening up of nuts will be effective with fewer injuries to his hands and fewer breakages of parts.

Thus standardization of this kind benefits all concerned, brings out the finer points of good design and manufacture, and establishes them as standard for the benefit of the consumer.

RECENTLY I spent two weeks going through my file of A. S. A. E. Transactions. I never found so much good material all in one place. I discovered information that I never knew existed. It was a revelation to me to find the things covered that interest me more than anything else. It is by far the most valuable set of books in my library. The information is almost perfectly organized so as to be instantly available. Then, of course, is the great advantage of having data and text matter that has authoritative sources back of it. I awoke to something I never knew I had. This one feature alone has paid big dividends.

E. R. Wiggins

Research Methods in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the Research Committee. Articles dealing purely with the manipulation of research methods and equipment are featured. Members are invited to discuss material presented and offer suggestions on timely topics

Some Research Features Involved in a Study of the Wooden Fence Post as a Structural Timber

By R. W. Trullinger

Mem. A. S. A. E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

Editor's Note: In the course of his analysis of the research features entering into a study of the fence post as a structural timber, Mr. Trullinger says that much to his surprise it developed into a rather pressing research subject. Many of the state agricultural experiment stations have been carrying on studies for some years, and at least sixteen are now engaged in the formulation of further studies. It, therefore, seems quite timely to attempt to place this work on a definite research engineering basis. The purpose of this article is to submit an apparently obvious subject, one actually little known from the engineering viewpoint, to analytical treatment, not only to clarify the problem and indicate the method of attack, but more especially to institute the procedure involved in such an analysis.

THERE are many localities were, for various reasons, wood is the logical fence post material for many kinds of service and probably will be for some time to come. However, the wooden post is no longer a cheap stick of wood, but a relatively valuable piece of timber, frequently subjected to expensive preservative treatment and of alarmingly short life in service in many cases. The investment in labor and materials which it represents is of such consequence on some modern farms as to make economical permanence an overwhelmingly important consideration. The available data indicate that on account of the type of service they must render the useful length of life of fences frequently compares somewhat unfavorably with that of many other farm structures designed and erected by modern agricultural engineering methods. Furthermore, a fence failure, if not anticipated and prevented, may be a serious matter if it protects a valuable crop, incloses valuable stock, or pens vicious animals.

The subject of the wooden fence post as a material for durable engineering construction is one about which we know much in general and but little of an intelligently correlated nature such that it can be applied to specific fence problems involving specific conditions of service. For example, much information is available relating to structural mechanics, the mechanical and physical properties of many kinds of woods when stressed in different ways, and the influence of different antiseptics, disinfectants, and waterproofing and weather-proofing treatments on the tendencies of different woods to decay under certain conditions. But precise information relating to the ability of a certain practical size and shape of post of a certain kind and condition of wood, treated in a certain specific manner to withstand the stresses imposed by the impact of animals or implements, for instance, after having been in service for any given length of time, is practically nonexistent.

Much of the investigational work which has been done in the past on the fence post as a structural material has emphasized mainly the pathological and chemical phases of the durability of the wood without particular reference in many cases to the specific requirements imposed upon it as an important member of an engineering structure. The inquiries and comments received by the Research Committee of the American Society of Agricultural Engineers indicate that several of our leading agricultural engineers are not satisfied that many such previous studies have been entirely adequate. These, considered together with the fact that many wooden fence post studies have been undertaken and that about sixteen projects on some phase of the subject are either in operation now, or are in process of formulation at as many state experiment stations, would indicate that the problem of the wooden fence post as a durable material for an important member of a specific structure is probably far from being solved, especially in view of the wide range of conditions imposed in service. This means that agricultural engineers have plainly been neglecting a problem, the main part of which is distinctly their own. It is evident, therefore, that something of a more specific nature should be done to adapt wooden fence posts to the particular service which they must render, as an important necessary preliminary to economical as well as effective preservative treatment. In addition, since comprehensive fence post studies usually involve a quite considerable investment in time and materials, it is important that they be begun properly and at the right point, and that they be conducted so that eventually they will attain a very definite and very practical objective.

It is therefore the purpose of this paper to analyze briefly the general subject of the wooden fence post as a structural timber in order to bring to light some of the more important features involved which seem to merit investigation from the engineering viewpoint, and especially to emphasize some of those distinctly agricultural engineering features which seem to have been more or less neglected in previous efforts to develop durable fence post materials out of wood.

Broadly speaking, the purpose of a fence post is to support gates and fencing effectively and economically for a maximum length of time under the entire range of conditions or service which a locality may impose. This implies that a fence post is subjected to stresses of a more or less definite nature, which are a composite not only of those incident to the mere supporting of fencing but also of those incident to the various phases of service which the fence itself may be required to perform on a farm.

While at the time of erection of fences the factors of safety of the posts are usually quite large, as far as the types of service they are required to render are concerned, a vast amount of experience indicates that the ability of wooden posts to deliver the service required gradually decreases under the deteriorating influences of decay, weather, repeated stresses, the action of insects, etc., while the stresses imposed are likely to remain more or less constant. Thus, sooner or later, according to the kind, size, shape, and condition of the posts and the conditions of service, the factors of safety become less than unity and the posts and consequently those parts of the fence which they support fail. Therefore, everything considered, it would

seem that a study to determine the nature, amount, distribution, and variation of the stresses to which fence posts will be subjected under the entire range of climatic and service conditions of the locality is justified as the first important preliminary step in gaining an exact knowledge of the fence post as a structural timber.

While such an analysis obviously can not be entered into in this paper, it may be well to draw attention to some of the features of which such a process might consist. The first consideration, of course, would be the loads. The main dead load, for instance, would be the weight of the fencing and gates for the majority of conditions. The weight of the fencing is a vertical load, usually slightly eccentric, and transmitted to the posts by means of staples, nails, or other fastenings. Thus the holding power of these fastenings under the amount and nature of application of the fence weight load becomes a factor for consideration, especially in view of the influence of decay and other deteriorating processes on such holding power in service.

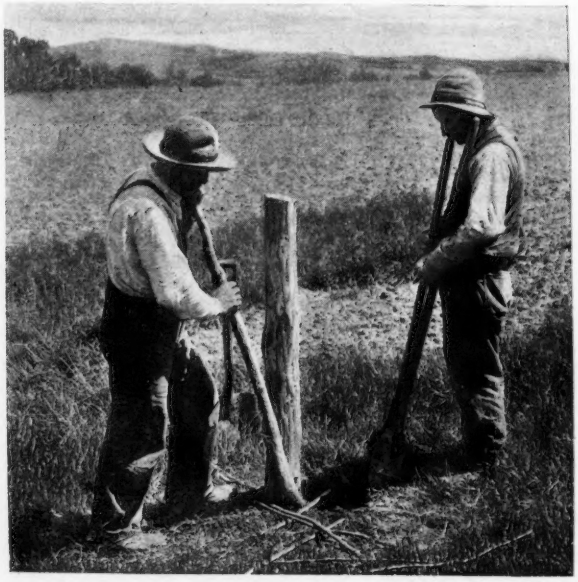
The gate load is also a vertical load, the eccentricity of which is, however, obviously great enough to impose a marked bending load on the gate post, especially when the gate is swinging open. The practice of using braces at right angles to the gate post is obviously an outgrowth of this requirement. The holding power of the gate fastenings to posts under conditions of gate operation is also a factor to be considered. The load due to stretching of wire fencing during erection, while borne by all the posts to a certain degree, is especially imposed upon the corner posts, thus contributing to the necessity of bracing corner posts. Other different loads may occur according to the specific condition of service. Incidentally, this suggests that the differences in the requirements imposed upon main fence, corner, and gate posts may possibly introduce a corresponding economic gradation in sizes and kinds of posts.

The live loads will probably include wind loads, loads due to persons or animals climbing over the fence, and loads due to stock or farm equipment leaning against the fence, as probably the most important. Here also the question of the holding power of fence fastenings becomes quite an important consideration, especially under conditions of repeated loads. The specific conditions of service may also impose other and even more important live loads. However, just how important these dead and live loads are, especially with reference to the impact loads, is a matter which apparently has never advanced beyond the speculative stage. The impact loads will probably be limited to those imposed by stock and by wagons and machinery. The question arises as to whether or not such impact loads will, if properly considered, adequately provide for the stresses caused by either or both of the dead and live loads. The apparent probability of this would seem to warrant giving the matter quite thorough consideration.

The determination of the nature, amount, and distribution of the resulting stresses in the posts by means of the application of the principles of structural mechanics should obviously be based upon as exact a simulation as possible of the imposition of stresses on the posts in actual service. The purpose is to secure a clear and accurate perspective of the maximum stresses which will be imposed upon fence posts in service, the points of their application, and the direction of their action. Obviously then, in the resolution of the live and impact stresses the application of the loads should be assumed at points which will produce the maximum stresses consistent with the practical aspects of service. Furthermore, the estimation of such stresses will probably be based upon an assumption of rigid or practically rigid settings. Therefore, depth of setting, area of underground portion, resistance of the soil or other material in which the post is set to service stresses, and other factors influencing the development of rigid settings become important matters for consideration.

With the available knowledge of the structural strengths of concrete, steel, and different kinds of woods, it should be a relatively simple matter, with the data determined on stresses, to design fence posts of these materials, using reasonable and economical factors of safety, which will meet service conditions satisfactorily for a time at least. However, the wooden fence post problem is now, more frequently than not, one of the utilization of locally and economically available woods of more or less fixed sizes and shapes. This precludes one of the greatest possibilities of design which would accurately indicate shape and dimensions to obtain economically effective sections. The U. S. Forest Service, the U. S. Bureau of Standards, and several state experiment stations have shown that shape, size, and structure, as well as species and manner and degree of seasoning, of fence posts may materially influence their

EVEN so simple a thing as the wooden fence post opens up an extensive field for agricultural engineering research, for which there is a great need at the present time. When the farmer puts a wooden fence post into the gound, he thinks little or nothing about the purely technical factors involved in the life of that post and the service it will give; that isn't his job. It is the function of the agricultural engineer to consider and investigate these factors and discover ways and means by which that post can be made more durable as a structural timber. From the standpoint of economy, durable engineering construction is as important in the lowly fence post as it is in any other type of construction; the present need is for a study of the requirements imposed upon it as an important member of an engineering structure.



strength. The Minnesota station has brought this out especially with reference to white cedar posts. This indicates the importance of taking stock of the different shapes, sizes, kinds, and conditions of timbers economically available for use as fence posts from the standpoint of the knowledge obtained as to service requirements. Several state agricultural experiment stations, among them the Iowa, Minnesota, Missouri, and Idaho stations, are already engaged in doing this to a certain extent at least.

The logical first procedure in this connection would then seem to be to conduct mechanical tests in the laboratory to determine the ability of a sufficient number of suitable samples of the different kinds, shapes, sizes, and conditions of woods economically available for fence posts to resist the determined stresses, in amount and manner, exactly as they are imposed in actual service. A comparison of the results of such tests with the corresponding service requirements should indicate the natural or initial factors of safety of these economically available wooden posts for local fence post service.

Knowing that the initial factors of safety of such posts as determined by these tests are valid for only a short time after the beginning of actual service, it is quite conceiveable that some of the less durable woods might have so small a margin of safety as to be rejected at the beginning, particularly for the more severe conditions of service.

Knowing that the initial factors of safety of such posts as determined by these tests are valid for only a short time after the beginning of actual service, it is quite conceivable that some of the less durable woods might have so small a margin of safety as to be rejected at the beginning, particularly for the more severe conditions of service.

Again the rejection or retention of some woods might be governed largely by the rate at which their factors of safety decrease through deterioration in actual service. This naturally suggests the importance of a series of comparative service tests of the different available sizes, shapes, kinds, and conditions of wooden posts having apparently adequate initial factors of safety, to cover the entire range of service conditions in the locality, to indicate as they progress the relative rates of decrease of the factors of safety of the different posts, and to establish an economic relationship between this rate of decrease and the original factors of safety. Thus posts having adequate factors of safety at the beginning may deteriorate too rapidly in service to justify their use as fence posts in the economical sizes, shapes, and conditions available. This was found to be the case, for instance, in tests of willow posts on an experimental farm on one of the U. S. Reclamation Service projects. Data on the influence of various periods of service on the ability of the different posts to withstand repeated stresses of the particular kinds encountered in service, as well as the influence of species, degree of seasoning, and physical condition on the rate of decrease of factors of safety should also be quite significant.

Preservative Treatment to Retard the Decrease in Factors of Safety of Posts During Service

The importance of these service tests will become more apparent, especially from the economic standpoint, when the data obtained are compared with similar data for posts subjected to preservative treatment to determine the points at which such treatment can be economically begun.

However, the matter of preservative treatment to retard the decrease in factors of safety of posts during service involves a number of problems which must be solved for the specific conditions of the locality in question before an intelligent comparison of this nature can be made. Much work has been done which has consisted merely of comparative tests of the influence of arbitrarily chosen preservative treatments on the length of life in service of wooden posts without particular reference to their sizes, shapes, conditions, or degrees of seasoning or the environmental conditions of service.

This highly important phase of the work merits a more fundamental treatment, involving a consideration of the agencies causing deterioration of wooden fence posts in specific types of service, as a basis for the selection or development of treatments best adapted for the economic eradication of such deteriorating agencies or the retardation of their influences to a minimum. The results of a long line of studies by the U. S. Forest Service, by several of the state experiment stations, and by several private research institutions, including the American Wood Preservers' Association, bear out this assertion.

It would seem that this is the point at which agricultural engineers should secure the cooperation of wood technologists and pathologists or other specialists dealing specifically with the deterioration and destruction of wood by chemical action or the action of fungi, bacteria, or insects, and the prevention thereof. Much information already has been made available by the U. S. Forest Service and other institutions as to agencies destructive to wood under the conditions of many localities and preventive measures therefor. Where information of this nature, applicable to local conditions, is not yet available, the specialists mentioned should know best how to obtain it. This is believed to be at least one phase of the fence post problem in which it is the duty of the agricultural engineer merely to present requirements which the other specialists should meet. It is quite important, however, that the requirements be complete in order that this work may consider all phases of the deteriorating influences on all practical sizes, shapes, conditions, and species of economically available wooden posts, both within the soil and in the air, under the entire range of types of service, methods of setting, and other environmental conditions of the locality.

The Influence of Preservative Treatment on the Mechanical Properties of Fence Posts

The importance of a consideration of the influence of method and degree of preservative treatment upon the mechanical properties of posts has been emphasized in studies by the U. S. Forest Service and the Massachusetts Institute of Technology. These have indicated, for example, that certain treatments, such as the use of creosote and zinc chlorid in various ways and amounts, may have a marked influence on the mechanical properties and strengths of some woods. This would indicate the desirability of conducting laboratory studies of the mechanical properties of all the fence posts subjected to preservative treatment by the cooperating specialists. Such mechanical tests should obviously be conducted on the same basis and in the same manner as those on the untreated posts, and the same shapes, sizes, kinds, and conditions of posts should be used throughout. It is quite possible that the results of such mechanical tests may indicate the necessity for a material modification in methods and degrees of preservative treatment in order to combine a maximum resistance to deterioration with a maximum strength for the different woods when used in practical shapes and sizes as posts. They can therefore be considered not only as studies of strength but also as tests supplementary to and verifying those on preservative treatments.

Furthermore, from the purely engineering viewpoint, these mechanical tests should indicate the factors of safety of the treated posts before being put into service and should permit a quite interesting comparison of the factors of safety of treated and untreated posts of the same size, shape, kind, and condition of wood before use. A careful search has failed to reveal the details of any study calculated to establish just such a relation for specific conditions of service.

With the knowledge made available by the studies noted above, a series of service tests of the treated posts would seem to follow logically. These service tests should obviously correspond exactly with those on the untreated posts and should therefore be conducted parallel therewith in order to insure an exact duplication of service conditions. They should also be of sufficient scope to permit of constant comparisons of service strengths and factors of safety of the treated and untreated posts after different periods of service. This should yield quite interesting and valuable information relating to comparative general rates of deterioration in service, types of woods, and shapes and

sizes of posts of different woods in which approved preservative treatment is most economically effective for specific conditions of service and the points at which preservative treatments begin to become economically effective.

It would seem that with such knowledge obtained from a sufficient number of years of study we should be able to indicate with a reasonable degree of accuracy and confidence the types of fence post woods, the sizes, shapes, and conditions of posts of different woods, and the nature of the preservative treatments and conditions of setting which are best adapted to give the maximum length of effective and economical service under the specific conditions of a particular locality.

It is realized that numerous matters have been brought to light in this discussion, each one of which might perhaps be made the subject of a quite interesting and profitable study. It is also realized that probably very few institutions are equipped to cover them all in a comprehensive and intelligent manner. This would seem to argue the importance of the development of cooperative relations between research institutions with an effective allocation of the different phases of the work as an objective. Obviously, strong cooperative relations with specialists in sciences other than engineering which have a marked bearing on the feature of the problem in hand are also of paramount importance.

This discussion of the fence post problem has been begun with the object of stimulating interest and profitable further discussion. Important features may have been omitted, the accuracy of others may have been a trifle stretched, or the importance of others may have been overestimated. If so, it is up to the membership of the American Society of Agricultural Engineers not only to draw attention to these errors and omissions but constructively to rectify them. The Research Committee will attempt ultimately to coordinate all such discussion into a constructive plan of procedure for placing the solution of the problem of the fence post on a sound fundamental basis.

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Coming Into Its Own

HE who doubts that agricultural engineering is not rapidly coming into its own, will not have to look very far these days to find plenty of evidence that such is the case. It can be found on every hand. And one of the most encouraging things about it is that development is proceeding pretty much along sound engineering and economic lines; it is anything but a mushroom growth. Also the profession is rapidly gaining the recognition it deserves, largely through the activities of the A. S. A. E.

Survey of Agricultural Engineering Progress

A review of current literature on engineering as applied to agriculture prepared monthly by Robert W. Trullinger, Mem. A. S. A. E., specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Some Compressive Tests of Hollow Tile Walls, H. L. Whittemore and B. D. Hathcock. (U. S. Dept. Com., Bur. Standards Technology Paper 238 (1923), pp. 513-527, pl. 1, figs. 5). Tests of 32 walls built of hollow tile are reported. The walls were either 6, 8, or 12 inches thick and 4 feet long by 12 feet high. About half were built with the cells of the tile vertical and half with the cells horizontal. A few walls of each construction were tested under a load having an eccentricity of 2 inches. Considerable differences in the strengths of individual tile did not have an appreciable effect upon the strength of the wall. No relation was found between the ultimate strength and the load at first crack.

The stress at failure computed on the net sectional area was remarkably constant for tile on end, being independent of the size of the tile. Walls having cells of the tile vertical had on the average more than twice the strength of those having the cells horizontal. Walls loaded with an eccentricity of two inches, over one-half the width of the wall, had about one-half the strength of similar walls axially loaded. Apparently this ratio was independent of the thickness of the wall. No relation was established between the modulus of elasticity of the walls and that of the tile.

Low Temperature Tars and Wood Preservatives, R. P. Soule (American Wood Preservers' Assoc., Proceedings 19 (1923), pp. 114-127, figs. 9). Studies are reported, the results of which are taken to indicate that the low temperature creosotes have the same penetration and absorption as ordinary creosotes. Their resistance to evaporation is greater, their toxocity is considerably higher, and they are even less corrosive to steel and brass than the coke-oven and gas-works products.

The Destructive Distillation of Wood, H. M. Bunberry (London: Benn Bros., Ltd., 1923, pp. XX + 320, figs. 108.) This publication describes plants, processes, and methods adopted in modern wood distillation practice, and gives an account in some detail of the physical and chemical properties of wood. It contains chapters on the rise and development of the wood distillation industry; varieties of wood employed; the physical properties of wood; the chemistry of wood; commercial products resulting from the thermal decomposition of wood; factors influencing the thermal decomposition of wood; the crude products of distillation; the thermal decomposition reactions; wood distillation on a commercial scale; the factory; wood distillation plant and operations—(1) the production of charcoal and crude pyroligneous acid, (2) the production of dilute calcium acetate solution and wood alcohol, (3) the production of dry calcium acetate, refined wood alcohol, pure methyl alcohol, refined wood turpentine, and pine oils, (4) the production of wood tar, wood oils, and wood pitch, and (5) the destructive distillation of small wood and wood waste; the production of illuminating and power gas from wood; analytical methods; and statistics.

Present Status of Sanitary Engineering: Suggestions for objects and aims of the sanitary engineering division. H. P. Eddy (Amer. Soc. Civ. Engin. Proc., 50 (1924), No. 1, [pt. 31], pp. 3-12.) The present status of sanitary engineering is discussed, and the objects and aims of sanitary engineering work are outlined under the subjects of water supply and purification, sewerage, drainage, and the disposal of sewage and industrial wastes, refuse collection and disposal; eradication of the mosquito and other vermin which may carry infection; and air supply and purification.

Fertilizer Distributors, G. Fischer (Zeitschrift fur Pflanzerernohrung und Dungung, Leipzig, 2 (1923), No. 2, Wirtschaft.-Prakt, pp. 92-97.) This is a brief discussion of the important points to be considered in the development of fertilizer distributors, particularly for the more dusty fertilizers.

The Relation of Highway Research to Modern Road Construction, A. T. Goldbeck (In Lectures on Engineering Practice, Baltimore: Johns Hopkins Press, 1923, pp. 9-48, figs. 19.) This is essentially a description of a number of the primary researches being conducted by the U. S. D. A. Bureau of Public Roads and a brief discussion of the relation they bear to the design and construction of highways.

A Treatise on Gear Wheels, G. B. Grant (Philadelphia: Philadelphia Gear Works, 1923, 16, ed., pp. [1] + 105, figs. 169.) The theory of different kinds and types of gear wheels is presented in this treatise.

The Design of Diagrams for Engineering Formulas and the Theory of Nomography, L. I. Hewes and H. L. Seward (New York and London: McGraw-Hill Book Co., Inc., 1923, pp. XIII + 111, figs. 83.) This is a practical treatise on the principles of the design of diagrams for the solution of engineering and other formulas, the purpose being not merely to give elementary methods of drawing simple diagrams but also to develop the grasp of the reader so that he will be able to analyze the more complex formulas of engineering practice. It contains chapters on function scales, elementary diagrams, alignment diagrams or collinear nomograms, alignment diagrams for formulas in more than three variables, alignment diagrams with two or more indexes, and alignment diagrams with adjustment, and appendixes on determinants of the third order and the projective transformation.

Stresses in Framed Structures, G. A. Hool and W. S. Kinne (New York and London: McGraw-Hill Book Co., Inc., 1923, pp. XIV + 620, figs. 384.) This volume is intended to cover the design and construction of the principal kinds and types of framed structures. It contains sections on general theory; roof trusses; bridge trusses, lateral trusses and portal bracing; deflection of trusses, redundant members secondary stresses; statically indeterminate frames; wind stresses in high buildings; and rectangular tower structures.

Farm Equipment for Mechanical Power, F. N. G. Kranich (New York: McMillan Co., 1923, pp. XIV + 405, figs. 320.) This book deals with farm machinery and its operation, with particular reference to the use of mechanical power. Part 1 on draft machinery contains chapters on the plow, harrows, land rollers and pulverizers, drills and seeders, mowing machines, haying machinery, grain binders, corn binders, push binders and headers, combined harvesters, manure spreaders, wagons, road machinery, miscellaneous machines, and testing machinery for draft. Part 2 on belt-driven machinery contains chapters on belt speeds, lining up and setting, threshing machinery, silage cutters, corn shellers, husker shredders, clover hullers, pea and bean threshers, feed grinders, wood saws, baling presses, and irrigation pumps. Part 3 on miscellaneous topics contains chapters on engine cultivators, garden tractors, belts and belting, pulleys and pulley coverings, chains and sprocket wheels, lubricants and lubrication, tools and shop equipment, housing machinery and winter storage, and ordering repair parts.

Heat Emission From Heating Surfaces of Furnace, A. P. Kratz (Jour. Amer. Soc. Heating and Ventilating Engin., New York 30 (1924), No. 1, pp. 29-33, figs. 3.) A study of several series of warm-air furnace tests conducted under varying conditions with a cast-iron circulator radiator type of Warren air furnace operating on anthracite coal is reported. The purpose was to indicate the amount of heat emission from the heating surface of a warm-air furnace and the relative value of the different parts of the heating surface as a basis for the intelligent design of such furnaces.

The heat emission per square foot of heating surface was found to be independent of the type of casing or bonnet for a given set of castings. In the furnace tested approximately 30 per cent of the total heat emission came from the fire pot, 40 per cent from the combustion chamber, 24 per cent from the radiator, and 6 per cent from the ash pit. For a cast-iron circular radiator type of furnace, 1 square foot of surface in the fire pot is equivalent to approximately 1.9 square feet in the combustion chamber, 5.9 square feet in the radiator, and 6.7 square feet in the ash pit. At a mean combustion rate of 7 pounds per square foot of grate surface per hour, approximately 75 per cent of the heat emitted by the heating surfaces appeared as useful heat in the air circulated, based on the heat in the air at the bonnet of the furnace.

The Occurrence of Ground Water in the United States, O. E. Meinzer. (U. S. Geol. Survey, Washington, D C., Water Supply Paper 489 (1923), pp. XI + 321, pls. 31, figs. 110). This is the first of a series of six papers on ground water in the United States. It deals with the principles of occurrence of ground water, kinds of rocks and their waterbearing qualities, structure of rocks and its influence on ground water, and waterbearing formations in the United States.

Water occurring below the surface of the earth is briefly classified as interstitial water, water in the mineral matter forming solid rocks, and internal water. The interstitial water includes suspended subsurface water, comprising soil water, intermediate vadose water, and fringe water; ground water, comprising gravity water and water not under the control of gravity; and subsurface or interstitial ice.

It is shown that among all kinds of rocks the best waterbearers are deposits of gravel. Next to gravel come sand, sandstone, limestone, and basalt. Among the many kinds of rock material that do not yield water freely but are nevertheless drawn upon where first-class aquifiers are lacking are the fine-grained and poorly assorted unconsolidated deposits and the hard rocks with only tight joints. The most completely unproductive of all materials are the true clays and fine silts, whose original interstices are

too minute to yield water and which are too soft to have joints or other secondary openings.

In order to affectively summarize the occurrence of ground water in the United States, the country is divided into 21 ground water provinces.

The Ohio Dynamometer, G. W. McCuen. (Agricultural Student, Columbus, 30 (1923), No. 3, pp. 59-62, 76, figs. 10.) A portable recording dynamometer using an internal-combustion motor as a prime mover is described, which was recently developed at the Ohio State University. Its purpose is to indicate the power requirements of belt-driven machinery.

Studies of the power required in threshing showed that careless pitching of bundles caused the thresher to consume 19.3 per cent more power than steady pitching. When the grain was thoroughly dry the horsepower consumption was 4.7 per cent less, although the rate of pitching was faster. Wheat threshing consumed 22.69 per cent more power than oats.

In hay and straw baling the horsepower requirement decreased as the density of the material to be pressed increased. In ensilage cutter tests even feeding required 14.5 per cent more power than uneven feeding. While the data seemed to favor uneven feeding, erratic feeding caused severe strains on both the cutter and prime mover. Dull knives utilized 14.78 per cent more power than sharp knives and the power consumption was inversely proportional to the length of cut.

Hydraulic Tests of Flap Valves on Drainage Pipe Outlets, F. A. Nagler. (Engineering News-Record, New York, 91 (1923), No 26, pp. 1052, 1053, figs. 3.) Experiments conducted at the University of Iowa to determine the angles of repose, loss in head, and leakage of double hinged cast-iron flap gates of the Calco type in sizes 18, 24, and 30 inches in diameter when attached to the end of a 10 of 12 foot length of corrugated pipe of the corresponding diameter are reported.

The loss in head through each gate was observed with outlet velocities of from 1 to 8 feet per second, while the corrugated pipe to which the gate was attached flowed either partially or entirely full, with the jet at the outlet either discharging freely in the air or entirely submerged.

It was found that the angle which the shutter makes with the vertical was practically the same for the various gates tested for conditions of both a free and submerged outlet. Thus with the outlet flowing full with a mean velocity of 6 feet per second, the shutter rested at an angle with the vertical of 39 degrees if the jet discharged freely into the air, and at an angle of 60 degrees if the gate was submerged.

The loss in head caused by any gate was less than 0.01 feet under all velocities of flow when the water discharged freely into the air. A maximum loss in head was reached for all three gates with a submerged outlet when the velocities of flow were between 2 and 3 feet per second, in which case the shutter hung at angles between 23 and 34 degrees with the vertical. The loss of head in all experiments was small, reaching a maximum of 0.116 feet for the 30 inch gate.

Tests of the 30 inch gate for leakage, when firmly held against its seat by backwater, showed that the maximum leakage with heads varying from 1.6 to 4.5 feet on the center of the gate was 0.015 feet per second, the leakage decreasing with increase in head.

It is concluded that the loss of head through gates of the Calco type is very small and that such gates have but little effect upon the discharging capacity of drainage outlets. It is also concluded that if they are kept free from twigs and debris and properly installed, they may be depended upon to stop effectively the inflow of backwater.

Measuring Heat Transmission in Building Structures and a Heat Transmission Meter, P. Nicholls (Journal American Society Heating and Ventilating Engineers, New York 30 (1924). No. 1. pp. 35-70, figs 30.) This paper deals with the measurement of heat flow through walls, more particularly of existing structures, outlining the principles employed, and describes in detail work done in the research laboratory of the American Society of Heating and Ventilating Engineers in an attempt to develop a heat transmission meter which will indicate instantaneous flows. A short review of the present state of available knowledge, future requirements, and indications of the probable trend of investigational work on the subject is included.

Highway Research in Illinois, C. Older. (Amer Soc. Civ. Eigin Proc., 50 (1924), No. 2, pp. 173-217, figs. 26.) A description is given of a series of research projects planned to get an insight into and understanding of the unsolved problems of rural pavement design. The principal problems under investigation include the drainage of subgrade soils, the effect of repeated bearing pressures on soils, the effect of temperature changes on pavement surfaces, the position of wheel loads as affecting stresses in pavement slabs, impact resulting from moving wheel loads, and the fatigue effect of repeated load bending stresses in plain concrete. The data obtained from a test road so constructed as to eliminate the variable factor of subgrade bearing power are also summarized.

The impact tests yielded results obtained for wheel loads of 4,000, 6,000, and 8,000 pounds, dropping ⅛, ¼, ⅜, and ¾ inches at truck speeds varying from about 1 to about 20 miles per hour with constant unsprung weight. The results showed that for all heights of drop the equivalent static load or the deflection at the critical point with an increase in speed decreased to a certain minimum, then increased more or less gradually. In amount this reduction in equivalent static load showed a distant tendency to increase with the increase of load above the springs. This was especially true in all cases of dropping load and to a less degree for the ⅛ and ¼-inch vertical rises. The difference between the minimum and maximum equivalent static load was not greatly affected by the change in load. For all heights of drop this resulted in a lowering of the impact factor.

At all speeds for the ⅛-inch drop and the ⅛-inch rise with the truck fully loaded, the equivalent static load was less than the static load of the wheel. For the ¼-inch drops with the truck fully loaded, the equivalent static load was less than the truck wheel load until the speed of the truck exceeded about 12 miles per hour, and did not increase materially for speeds in excess of 14 miles per hour. The maximum equivalent static load for the 8,000-pound wheel load was only a little greater than the wheel load itself. In mounting the ¼-inch obstruction the critical speed was about 10 miles per hour, and the equivalent static load did not increase materially for speeds in excess of 14 miles per hour. For the drops and rises of greater magnitude the critical point was passed at lower speeds, and the maximum impact effect was much greater.

Data on the warping of rigid pavement slabs due to temperature changes are considered to confirm the belief that rigid pavement slab corners frequently may be required to sustain passing loads while acting as unsupported cantilevers. Data on the influence of position of wheel loads on deflections indicate that stresses in corners may be greatly reduced if an effective method of doweling is provided.

Data on the fatigue of concrete indicate that plain concrete beams or slabs will sustain without failure from bending an indefinite number of repetitions of a load if the tensile fiber stress induced is less than 50 per cent of the modulus of rupture. For loads causing fiber stresses in excess of 50 per cent of the modulus of rupture, the tendency to failure increases rapidly with the increase of this excess of stress.

The subgrade soil investigations established that the bearing value of a clay soil varies with its moisture content. It is considered questionable whether attempts to control moisture by means of tile drains are of any merit in clay soils. It was found that brown silt loam and yellow clay soils resist further moisture saturation to a marked degree when they have a moisture content which is normal for the summer months. Other experiments indicated that if the moisture content of any of these clay soils is reduced to a point where the soil crumbles readily absorption takes place rapidly to the point of saturation.

Other results are taken to indicate that for perhaps a period of a year or more after a pavement is laid the bearing power of a clay subgrade soil may be affected materially by its moisture content at the time of construction. It is also considered probable that none of the clay soils exhibits sufficiently uniform elastic properties to justify an assumption of elastic subgrade supporting power for use in a design formula.

Data on the effect of truck traffic tests on different sections of the experimental road and notes on rigid pavement design are included.

Furnace Heating, W. G. Snow (New York: U. P. C. Book Co., Inc., 1923, 6. ed., rev. and enl., pp. 259, figs. 74.) This is the sixth edition of this treatise on warming buildings with hot air. It contains chapters on furnaces; househeating; the one pipe system; the combination system; air, humidity, and ventilation; the heating and ventilation of school buildings; heating of public buildings, churches, and stores; the fan furnace combination system; temperature control; estimates and contracts; fuels, miscellaneous tables, and data; furnace erection and fittings; and miscellaneous notes and data on furnace heating.

The Lower Limits of Concentration for Explosion of Dusts in Air, L. J. Trostel and H. W. Frevert. (Chem. and Metall. Engin., 30 (1924), No. 4, pp. 141-146, figs. 5.) The results of recent studies by the U. S. D. A. Bureau of Chemistry on the lower limits of concentration for explosion of powdered corn starch, corn elevator dust, standard Pittsburgh coal, powdered sugar, powdered aluminum, wheat elevator dust, and powdered sulphur with three different kinds of ignition are presented and interpreted in the light of industrial requirements. The three types of ignition used were the glower, arc, and induction spark.

A comparison of the limits for the three types of ignition showed that the heat capacity of the ignition source has a decided effect on the lower limit of concentration for explosion of dusts in air. The thermal properties inherent in the dusts were found to also affect the lower limit. Added to these effects is that of the specific heats of the various substances. The organic dusts, for instance, have the greater specific heat. The various specific heats have their effect on the flammability of thin suspensions, since the dust cloud particles absorb heat, and their capacity depends on the specific heat and on the ignition temperature. If the initial quantity of heat to be absorbed is comparatively large, combustion may not take place, depending somewhat on how much heat has been generated. In the case of wheat elevator dust for temperatures below 150 degrees Centigrade (302 degrees Fahrenheit), it was found that 67 per cent of the heat absorbed by the dust during the temperature rise to 150 degrees was taken up by the water and ash. This is taken to indicate that in accounting for differences in the explosibility of various dusts the dampening effect of moisture and ash apparently must be considered.

The chemical composition of the cereal dusts is considered of interest in explaining the variation in lower explosive limits of the substances studied. The fact that corn or wheat elevator dusts must be present in heavier concentrations than starch in order to explode is considered to be due probably in great measure to the large quantity of ash present in the elevator dusts as compared with that in starch. The difference in behavior of the two elevator dusts alone when exposed to an induction spark indicated that the crude fiber, making up 22.14 per cent of the wheat ele-

vator dust and only 3.58 per cent of the corn elevator dust, is not as flammable as starch.

The data give no definite general relationship between ignition temperature, lower explosive limit, soil flammability, and heat of combustion. Regardless of the type of ignition used or weight of dust suspended, coal and sulphur generally produced the smallest pressure upon explosion, and aluminum, or possibly starch, the greatest pressures, with sugar and the elevator dusts occupying an intermediate position. The reason for this is explained. The two dusts, coal and sulphur, which are alike in being the least violently explosive varied widely in lower limits. There seemed to be no special relation between relative flammabilities, which are determined mainly by the volume of gaseous products of combustion and the heat of combustion, and the lower limits of concentration for explosion of dust in air.

The Autotaxic Curve as a Means of Classifying Soils and Studying Their Colloidal Properties, A. E. Vinson and C. N. Catlin (Jour. Agr. Research [U. S.], Washington, D. C. 26 (1923), No. 1, pp. 11-13, figs. 4.) In a contribution from the University of Arizona, four auxograph charts drawn by a few southwestern soils are presented and briefly discussed.

The belief is expressed "that every dry soil swelling in distilled water at a given temperature will produce a characteristic autotaxic curve that can be duplicated repeatedly. This curve appears to integrate as least four properties of the soil: Texture, colloidal organic matter, colloidal inorganic matter, and soluble salts, and, indirectly, specific gravity, the original thickness of the 10 gram disk being determined by this factor. In addition to these properties of the soil itself, the curve integrates temperature, viscosity, and the presence of electrolytes and colloids in the medium in which the swelling occurs * * * It is believed that if a large number of autotaxic curves drawn on the same coordinates and representing the recognized soil types were recorded, they could be used in the classification of soils to the greatest advantage along with other methods now in use."

Studies of methods of determining the rate of swelling in soils showed that, while the autotaxic curve of many soils in distilled water under standard conditions is fixed, it may be modified by the addition of electrolytes, molecules such as sugar or colloids. Electrolytes in the water accelerate the rate of swelling. Twenty per cent of cane sugar retarded the swelling of calcareous clay. Small amounts of gelatin accelerated the rate of swelling, and large amounts retarded it. 'The fact that the same concentration of colloid has a markedly different effect on the rate of expansion of different soils suggests that here also may be found another means of studying the colloidal properties of different soils. Small amounts of electrolytes accompanying strong solutions of gelatin also greatly modify its effect."

An instance is cited in which the lateral crushing of a tile line was explained by the autotaxic curve.

Studies on the Treatment and the Disposal of Dairy Wastes, C. L. Walker et al. (New York Cornell Sta. Bul. 425 (1923), pp. 170, pls. 18, figs. 19.) Studies are reported to determine (1) methods that may be employed in successfully treating the various wastes developed in the dairy industry and their relative value, (2) the necessary degree of dilution of the wastes untreated or partially treated to prevent the development of offensive conditions in streams and to prevent injury to fish life therein, and (3) the effect of the various wastes on fish life. Nine different experimental units were used, and the wastes studied included only fresh milk and whey.

It was found that natural processes tend to destroy these wastes and render them harmless in a manner similar to that in which they assist in the purification of other organic wastes, and that supplemental methods of purification are needed only when the amount of waste present are in excess of those which nature can handle without the development of undesirable conditions. In certain instances the introduction of fresh milk wastes into a stream actually benefitted the stream in that they stimulated the production of fish food. The amount of wastes which a stream can satisfactorily dispose of was found to depend upon the temperature of the stream, the rate and volume of stream flow, the character of the stream bed, and the types of plant and animal life present.

The investigations of supplemental methods of treatment showed that the rearing of bloodworms in large numbers for the direct consumption of milk wastes is possible, but that the difficulties attending the rearing of these larvae render the results of waste treatment by them uncertain. The milk wastes were successfully treated by chemical precipitation with iron sulphate and lime. This treatment produced a clear, nonoffensive effluent, and the precipitated material is said to contain considerable fertilizer constituents.

From 75 to 95 per cent of the organic nitrogen could be removed from whey by adding a slight excess of lime over that necessary to neutralize acidity, boiling, and then passing the cooled effluent through a septic tank and a sand filter. Such sand filter effluent was, however, even with a 95 per cent reduction of organic nitrogen, about two or three times as strong as a strong domestic sewage before treatment, and therefore could not be discharged into a small stream without danger of causing a nuisance, or of killing fish.

The activated sludge method of treating dairy wastes proved impracticable because of the large proportion of the offensive material in solution, the difficulty of developing sludge, and the difficulty and expense of operating such a plant where only small volumes of milk are handled and where the waste is discharged mainly in one or two hours.

A sand filter was found to purify milky waste septic tank effluents at rates ranging from 75,000 to 100,000 gallons per acre per day. A stone or more porous filter, such as a lath filter, could purify such effluents at rates ranging from 300,000 to 400,000 gallons per acre per day. These filters, however, did not give as high a degree of purification as the sand filter at one-fourth these rates.

Some form of settling and holding treatment for milk wastes was found desirable. Such treatment tended to reduce the total solids in suspension and the amount of organic nitrogen present, to decrease the loss on ignition of solids, and to render the wastes more alkaline. Settling and holding in an Imhoff tank were found undesirable, since the effluent from this tank is likely to clog filtering beds. The tank is also considered to be complicated and expensive to construct. Settling and holding in a septic tank are recommended, since the tank is simple to construct and the effluent from it has less tendency to clog filtering beds.

It is concluded that septic tanks should be designed to hold from one to three days' flow of waste, and, since the waste generally enters in large volumes for a short interval of time, the period of retention is uncertain. The use of a grit chamber is recommended to intercept dirt, sawdust, or other organic matter contained in the wastes from a dairy plant. The use of porous beds of sand, stone, or other material to further purify the effluent from the septic tank is also recommended. These beds were found to treat the waste at the same rate at which such filter beds would treat an average domestic sewage and therefore at the same cost.

Secondary sedimentation tanks are considered to be a necessary part of a treatment plant in which the filter material is coarse. The retention of the waste in such tanks need not exceed ten minutes for the removal of more than 90 per cent of the settleable solids.

Whey was found to have a toxic effect on fish life, causing death in a few hours in dilutions as great as one volume of whey in 25 volumes of water. At 14 degrees Centigrade (57.2 degrees Fahrenheit), one volume of milk wastes to 15 volumes of water may or may not cause distress to fish, and as the temperature decreases the proportion of milk wastes to water may be increased. Fish showed little or no discomfort in a mixture of one volume of milk to five volumes of water when the temperature was below 12 degrees. Fish would not live in water containing more than 0.75 pound of Wyandotte, Goldenrod, or Perfection washing powders to 100 gallons of water.

Milk wastes before or after tank treatment may cause the death of fish through suffocation by using up the available oxygen in the water. Short-time experiments covering a period of four or five weeks indicated that concentrations as great as one volume of waste to three volumes of water, and in cold weather undiluted waste, would not cause the death of fish, including small-mouth black bass and brook trout.

Milk wastes could be sufficiently purified by tank and filter treatment so that fish showed no distress in the undiluted effluent. Fish did not seem to be much distressed when the dissolved oxygen content did not fall below 1.5 parts per million. The biochemical oxygen demand of milk wastes was found to vary with treatment, requiring from zero to thirty volumes of water to one volume of waste. Allowing for absorption of oxygen from the air, this ratio may be considerably reduced.

A bibliography of seventy-seven references to literature is included.

Report on Investigations Into the Improvement of River Discharge Measurements, I-III, E. B. H. Wade, (Egypt Min. Pub. Works, Phys. Dept. Papers 4 (1921), pp. VII + 21, pls. 18; 6 (1922), pp. 12, pls. 14; 7, pp. 6, pls. 10.) This report is in three parts. Part I reports the development of a special ratchet gauge designed to overcome the influence of turbulence in streams. The gauge developed can not give any reaction in water which is flowing in the ideally simple manner. It can and does give a reaction when immersed in water in which differential movement exists. Experiments with this instrument at a number of stations which were known to be turbulent, and at which the discharges indicated by Gurley current meters were too high by determined amounts, showed that, as an average, an indication of about three units on the gauge scale corresponded to an excess of about 15 per cent in the current meter discharge.

In Part II it is shown that when the velocity of a stream is very low its measurement presents special difficulties and that there is a demand for an improved type of current to deal with the case of sluggish flow. The development of a current meter for this purpose is described, in which a helix is driven by an independent constant power and the effect of the stream is merely to increase or diminish the rate of the helix by an amount which serves as the measure of the velocity of the stream. Graphic data are presented from actual tests, indicating the advantage from using an independent constant power in this manner.

Part III deals with actual tests of the instrument described in Part II in making measurements of the discharge of the Blue Nile during the low stage. The low velocity current meter was compared with the Gurley instrument, using various driving weights and propeller angles. With a weight of 20.5 grams and a pitch angle of 25 degrees, a favorable rating curve was obtained which was, however, by no means free from flattening in the neighborhood of the slack water reading. With other values of the driving weight and pitch angle the flattening was more serious, and in the case where the pitch angle was 40 degrees and the weight 56 grams the amount of flattening and consequent loss of sensitiveness at low velocity was considered prejudicial to accuracy. Suggestions for preventing the flattening of the rating curve are made.

AGRICULTURAL ENGINEERING

The Journal of the
American Society of Agricultural Engineers

The American Society of Agricultural Engineers is a voluntary, technical organization of engineers and others concerned with problems in engineering as applied to agriculture. The Society serves a distinct, specialized field in both engineering and agriculture; it is the central clearing house for agricultural-engineering information, the recognized coordinating center for promoting agricultural-engineering development, and the chief point of contact for agricultural engineers in their professional activities.

AGRICULTURAL ENGINEERING is the Society's journal for keeping members informed of the activities and accomplishments of the organization, its committees, and individual members—the medium of expression of progress in agricultural-engineering science; it is also the vehicle for broadcasting generally agricultural-engineering information. Contributions of interest and value to the agricultural field are solicited from both members and non-members of the Society for publication in this journal. Its columns are open for the discussion of all phases of agricultural engineering; the editor welcomes communications on timely subjects of interest or on which the attention of the agricultural-engineering profession should be focused.

RAYMOND OLNEY, M. E. A. E.
Editor

New Interest in Farm Machinery

IT is ineresting to note that our state agricultural colleges and the federal department of agriculture, other than the agricultural engineering departments, that in the past have maintained almost a perfect silence on subjects pertaining to farm machinery, are now beginning to reflect a change in attitude. The following paragraphs from a statement recently issued by the department of rural economics of the Ohio State University are especially significant of this changed attitude and are particularly appropriate at the present time. Agricultural engineers will add an emphatic "Amen:"

"Methods of 1890 won't do in 1924. One of the factors of successful business management is to be able to sense just when to discard an old machine and replace it with another more up to date and efficient."

"The increased output (of the farm) has been accomplished by a more businesslike utilization of the labor and capital involved and especially by the adoption of labor-saving machinery."

"From all indications we are just entering upon a new period in the history of our agriculture, a period which will witness the adoption of many labor-saving devices and methods. Therefore, the farmer who is to compete successfully and to produce at a profit must be constantly on the alert to adopt all possible methods of reducing his costs."

"Labor-saving machinery, drainage, rotation, and other improved practices have made it no unusual thing for an Ohio farmer to handle one hundred acres of crop land single handed, a truly remarkable increase over twenty years ago."

Why Be a Member?

A REAL opportunity to make progress is opened to the individuals directly interested in any phase of agricultural engineering through membership in the American Society of Agricultural Engineers. Individual effort can do much to broaden the field for agricultural engineers, to emphasize their importance, to increase opportunities, and to be of service, thereby making better profit, but individual effort, no matter how efficacious, can take the place of a nationally organized society like the A. S. A. E.

By working together through a strong society, agricultural engineers from beginners to specialists can do more ways see ahead. Individual effort is indispensable, but cooperative effort through a national association is vitally necessary to greatest progress.

Regardless of our reactions to the short but mighty word "duty" there is no escaping the fact that men engaged in a profession or business should be members of the national organization of that profession or business. While it is a duty, it is also a pleasure which can be quickly verified by asking any active member.

Americans are noted for the spirit of always wishing to do "their" share. The individual interested in farm operating equipment, reclamation, farm structures, and farm home conveniences can best do "his" share in advancing the interests of his profession and of himself by actively participating in the meetings and committee work of the A. S. A .E.

F. A. WIRT

A. S. A. E. and Related Activities

General Outline of Program for 1924 Annual Meeting

THE following is a general outline of the program for the eighteenth annual meeting of the American Society of Agricultural Engineers to be held at Lincoln, Nebraska, June 18, 19 and 20, 1924:

June 17—Committee meetings, round-table conferences, excursions, demonstrations, exhibits.

General Program

June 18—2:00 P. M.—Address
8:00 P. M.—Business Meeting
towards obtaining those objectives that ambitious men al-

June 19—2:00 P. M.—Address
7:00 P. M.—Banquet

June 20—2:00 P. M.—Address

Section Programs

June 18—9:00 A. M. and 3:00 P. M.
Farm Power and Machinery Section
Reclamation Section
June 19—9:00 A. M. and 3:00 P. M.
Farm Structures Section
Rural Electrification Program
June 20—9:00 A. M., 3:00 P. M., and 7:00 P. M.
College Section

June 17 To Be Gala Day at Lincoln

A FEATURE of unusual interest, or it would be more correct to say a number of features, have been added to this year's annual meeting program. June 17, the day previous to the official opening of the Lincoln meeting, has been set aside for committee meetings, round-table conferences, excursions and demonstrations.

Any group which wants to hold a meeting on this day should get in touch with Secretary Olney. Suggestions regarding demonstrations and exhibits will be welcome. Here are the plans for June 17 as developed to date:

There will be a reclamation round-table and a field excursion to look over the work on soil erosion and drainage work in the vicinity of Lincoln. Prof. Sjogren will put on a tractor testing demonstration to show what steps are taken to conform with the Nebraska tractor law. The agricultural engineering department of the University of Nebraska will also have a number of exhibits, the nature of which will be announced later.

The Advisory Committee of the College Section will also hold a meeting on this date.

When this general plan becomes known there will, un-

doubtedly, be other groups that may wish to hold a committee meeting or round-table conference at Lincoln on June 17.

The latch string is out. What is done with June 17 will depend largely upon the initiative of various groups.

Report of Nominating Committee

FOLLOWING is the report of the Nominating Committee of the American Society of Agricultural Engineers, in which candidates for election to the several offices indicated, to take office immediately following the annual meeting in June and to serve one year, have been placed in nomination as provided by the Constitution of the Society. The Nominating Committee in submitting its report makes the following statement:

"It is the unanimous opinion of the present Nominating Committee that an attempt should be made to avoid the condition that has been criticised as placing the distribution of the Society offices in the hands of too limited a group of men, namely, the nominating committee, and while it is not its desire or aim to avoid in the least the responsibilities of its position, it has nevertheless seemed best to increase the possibilities for self-expression by the Society membership at large by making three nominations instead of one for each office, except that of treasurer. Accordingly, the list of men submitted in our report have been approached and have signified their willingness to appear on the ballot under these conditions."

Thirty days from the publication of this report, or from the time this issue of AGRICULTURAL ENGINEERING reaches members, the Secretary will prepare and mail secret letter ballots to all voting members. This intervening period is to allow special nominating committees to make additional nominations for the various offices.

For President
F. W. Ives, Columbus, Ohio
C. I. Gunness, Amherst, Massachusetts
L. J. Fletcher, Davis, California

For First Vice-president
R. U. Blasingame, State College, Pennsylvania
H. B. Walker, Manhattan, Kansas
H. R. Straight, Adel, Iowa

For Second Vice-president
W. A. Foster, Athens, Georgia
E. A. Stewart, St. Paul, Minnesota
G. B. Gunlogson, Racine, Wisconsin

For Treasurer
Raymond Olney, Mt. Clemens, Michigan

For Member of Council
R. W. Trullinger, Washington, D. C.
W. B. Clarkson, Owatonna, Minnesota
David Weeks, Berkeley, California

Nominating Committee
G. B. Gunlogson, Racine, Wisconsin
J. H. Swenehart, Madison, Wisconsin
C. E. Seitz, Blacksburg, Virginia
G. W. McCuen, Columbus, Ohio
E. R. Gross, New Brunswick, New Jersey
E. M. Mervine, Ames, Iowa

Investigation Program on the Relation of Electricity to Agriculture

AT the request of the Committee on the Relation of Electricity to Agriculture, the Office of Experiment Stations, U. S. Department of Agriculture, has agreed to assume the responsibility for the direction of the development of an investigational program on the relation of electricity to agriculture.

It is recognized that while this program may ultimately touch every recognized branch of agricultural education, it is preeminently related to agricultural engineering. Therefore, the agricultural engineers should be the ones to work out this program, but at the same time securing all the cooperation possible from other sources. R. W. Trullinger has been designated by the Office of Experiment Stations to have charge of the project. Members of the office staff working in other lines of agricultural investigation will make suggestions regarding the particular field in which they are interested. Cooperation will be had from the leading agricultural engineers of the country.

This is an unusual opportunity for agricultural engineering. Experimental results are not asked for in this instance, but a plan of investigation and investigation methods which will find the facts. The project involves all the problems in taking a new form of power to agriculture. Both the electrical industry and agricultural interests are looking to agricultural engineers to point the way. Success in outlining a comprehensive investigational program will go a long way toward establishing a recognition of agricultural engineering as one of the most potent forces in agricultural development. It goes without saying that agricultural engineers of this country are entirely competent to formulate a comprehensive and fundamental investigation program. Interested agricultural engineers should send their suggestions to R. W. Trullinger, Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.

Activities of Student Branches

University of Nebraska

THE A. S. A. E. Student Branch at the University of Nebraska has outlined a very interesting program for the second semester. The regular meetings of this branch are held the second Thursday of each month at 7:30 P. M. in the Agricultural Engineering Building.

At the first three meetings of the semester will be held preliminary demonstrations. The best student demonstrator is made chairman of his group for the final demonstration.

The branch will hold a one-day school Saturday, April 19, at which time the demonstrations made at the first three meetings of the semester will be repeated in full for the benefit of the public. Competent judges will select the best demonstration and the man giving the best demonstration before the public will get his traveling expenses paid to the next annual meeting of the Society. (The branch will be let down easy this year inasmuch as the annual meeting is to be held at Lincoln.) All agricultural engineers and students of the College of Agriculture with six hours of subjects in agricultural engineering will be eligible to enter this contest.

At the first meeting of the semester, February 14, the demonstrations included radio and automobile driving (for ladies). At the second meeting, March 13, demonstrations include features to consider in buying a car and headlight adjustment. The third meeting on April 10 will have demonstrations on woodworking and house planning.

The last two meetings of the semester, May 8 and June 5, will be devoted to seminar reports. The election of officers will take place at the final meeting of the semester on June 5.

Reforestation Promoted

PRESIDENT COOLIDGE has expressed himself as favorable to the purposes of the McNary-Clark reforestation bill which provides for a provision in the budget for an appropriation of $2,700,000. The bill aims at the establishment of a national reforestation policy. It provides for nationwide forest fire protective measures, for the extension of the national forests by further purchase and by additions from the public domain, and for the establishment of forest protection and conservation policies for each of the great timber regions of the United States, through cooperation of state and federal governments. Provision is also made for assisting farmers in the management of their woodlots, which altogether comprise more than one-third of the forest area of the United States, for the dis-

Studies With Ensilage Cutters

Where the Farmer's Dollar

The Third Message of a Series to Dealers, referring to the Problems of the Farm Equipment Industry

IN some of the stores of any town the farmer's dollar buys the necessities of life; in others it buys physical comforts; in still others it buys pleasures. *In the farm equipment store the farmer's dollar buys the means to make many more dollars.* It buys the equipment which, as much as the land itself, is responsible for his progress and prosperity. It buys machines that relieve him of drudgery, making farming a pleasanter occupation. When the farmer invests in modern farm machines, he is really buying clothing and education for his family, electric lights, automobiles, furniture, radio outfits, etc., for his convenience and comfort, because these things are purchased with the money made by farm equipment.

Of all the stores in town, *the farm equipment store is the one where the farmer gets the greatest return for his money.* That is a fact of great interest to any farming community, one that should give every farmer much food for thought.

The truth of this is evident when we consider the farmer's purchases from the standpoint of comparative prices; comparative materials; and comparative degrees of usefulness of the articles in question. One article by itself proves nothing, nor does one price. The proof is obtained only by comparisons.

The only practical way to compare prices of articles made of similar materials is on the basis of the price per pound. That is entirely fair when the materials go through the same machine shop and factory processes and are handled by the same class of labor. Such a comparison will show that *when the farmer buys farm machines and implements he pays less money per pound than he pays for any other similar manufactured article.*

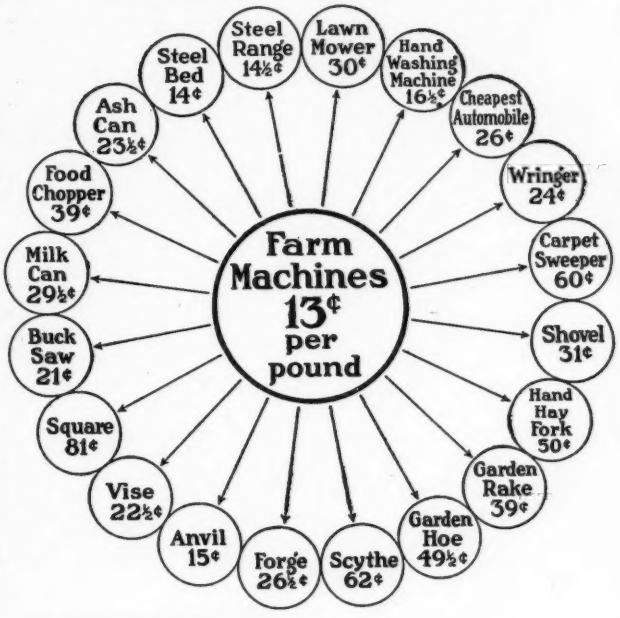
Buys the Greatest Value

For this comparison we have taken, First, a group of eleven basic farm machines: Sulky plow, peg-tooth harrow, disk harrow, grain drill, corn cultivator, corn planter, corn sheller, grain binder, mower, hay rake and farm wagon—and, Second, a list of common articles used on the farm but not classed as farm equipment. We have obtained the pound-price of these articles by dividing the retail prices by the weights. Freight to the dealer's store is not included, since it applies to all articles the farmer buys and varies with the distance from point of manufacture.

The chart at the right shows the prices per pound of the basic farm machines and other articles the farmer buys:

Ignore for a minute the *low figure* in the big circle and study the pound-prices of the miscellaneous articles. You will see that they range *all the way from 14 cents up to 39, 60 and even 81 cents per pound.* Even some of the simplest of them, made without any moving parts whatever, cost over twice the farm machine price. Yet these are not high-priced goods; they are ordinary, everyday articles made of the same materials that go into farm equipment, and the prices are accepted as fair by all buyers. The articles listed are of a standard line sold practically everywhere.

Now note the low average retail price per pound of farm machines. The *average* pound-price of these basic machines and implements, needed by every grain-growing farmer, is less than the *lowest* in the other group. Some of these farm machines have complicated parts in their makeup and all of them are built to stand years of hard use, yet—



The average price the farmer pays for these necessary farm machines is only 13 cents per pound.

A New Way to Show How Low Farm Equipment Prices Are

The above analysis shows that *farm machines are priced lower than even the most simple articles the farmer buys.* What would the farmer have to pay for farm machines if they were priced to him on the basis of other articles he buys? This list shows what they would cost:

A sulky plow, priced like a wringer, would cost about **$45 MORE**
A peg-tooth harrow, priced like a forge, would cost about **$30 MORE**
A disk harrow, priced like a buck saw, would cost about **$50 MORE**
A grain drill, priced like a food chopper, would cost about **$390 MORE**
A corn planter, priced like a forge, would cost about **$60 MORE**
A corn cultivator, priced like a vise, would cost about **$40 MORE**
A corn sheller, priced like a milk can, would cost about **$20 MORE**
A 7-ft. grain binder, priced like the cheapest automobile, would cost about **$200 MORE**
A 7-ft. grain binder, priced like an ash can, would cost about **$150 MORE**
A 5-ft. mower, priced like a lawn mower, would cost about **$80 MORE**
A hay rake, priced like a garden rake, would cost about **$110 MORE**
A wagon, priced like a hand washing machine, would cost about **$50 MORE**

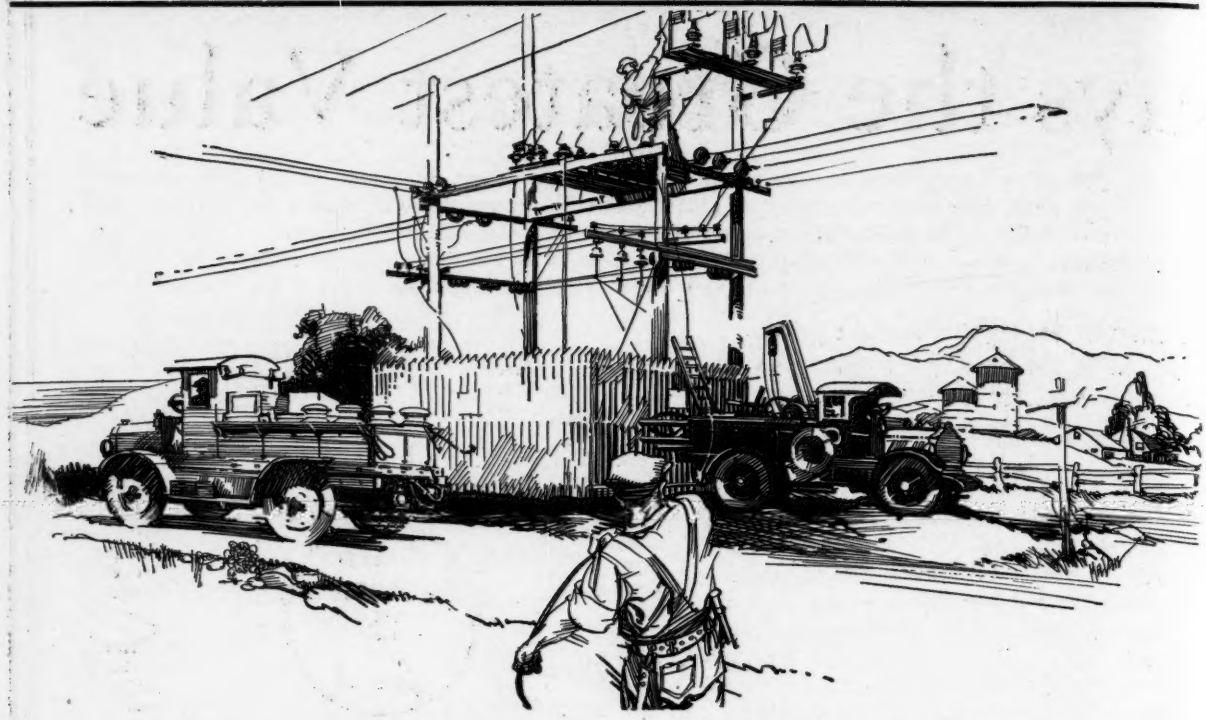
These comparisons, which can be duplicated in any community in this country, prove the statement that *the farmer pays less money, pound for pound, for the machines that do his work than he pays for any other similar manufactured article he buys.*

Research Department

National Association of Farm Equipment Manufacturers

608 So. Dearborn Street, Chicago, Ill.

1-1-'24



Farm Electrification *and the* American Society of Agricultural Engineers

THE American Society of Agricultural Engineers has a special interest in rural electrification. It is represented on the National Committee which has been created to study the problems involved. And some of its members are assisting in the experimental electrification of farms in several states. In these states there have been organized groups of farmers to whom electrical energy is experimentally supplied. Each group is an independent

NATIONAL ELECTRIC

self-controlled organization, which has the technical guidance of the engineers of its State Agricultural College. Accurate records of energy consumption, time and labor are kept.

The National Committee acts not only as an organizer of state experimental groups, but also as a clearing house of information. It keeps each group informed of the progress made and the results obtained by other groups. It receives reports, analyzes and interprets them. On the basis of the facts presented it makes recommendations which will mark stages in the evolution of a sound policy of farm electrification.

As the facts reported by the various state groups of farmers are tabulated and the necessary deductions drawn from them, both farming and agricultural engineering will be the gainers. A richer opportunity will be presented to the agricultural engineer. It will be his part to serve the farmer as the industrial engineers now serve manufacturing corporations.

The National Committee in charge of the work is composed of economists and engineers representing the Departments of Agriculture, the Interior, and Commerce, the American Society of Agricultural Engineers, the American Farm Bureau Federation, the Power Farming Association of America, and the National Electric Light Association.

A booklet has been published by the National Committee. Read it and pass it along to your neighbor. It will be sent free of charge. Write for it either to Dr. E. A. White, the American Farm Bureau Federation, 58 E. Washington Street, Chicago, Ill., or to the National Electric Light Association, 29 West 39th Street, New York City.

LIGHT ASSOCIATION

tribution of tree-planting material, and for the initiation of a revision of state taxation laws, which are generally inimical to commercial reforestation.

The bill represents the conclusions of the Senate Select Committee on Reforestation, which has been studying the problem for about a year. It is believed that its enactment will mark significant progress in the development of a sound, farsighted national policy for forest conservation.

Personals

H. R. Burr, who prepared and built up the agricultural course at Williamson Trade School, Pennsylvania, and who served twelve years as agricultural director at that institution teaching those branches relating to agricultural engineering, recently resigned to become affiliated with the Waunakee Canning Company, Waunakee, Wisconsin, of which he is vice-president and director. Mr. Burr designed and built a three-story plant for this company with a capacity of 200,000 cases of peas and corn, ready to operate this season. Mr. Burr is also offering his services as consulting agricultural engineer.

Kurt Grunwald, a consulting agricultural engineer, Medford, Long Island, New York, who is taking a leading part in developing the sugar-beet industry of Long Island, recently issued a bulletin, entitled "Synopsis of Sugar Situation and the Development of Long Island to Sugar Beet Culture." A recent issue of the monthly information bulletin of the Long Island Railroad contained a two-page article which reviews the very creditable work Mr. Grunwald is doing in connection with the Long Island sugar beet development.

STANLEY F. MORSE, a consulting agricultural engineer, is the author of an article entitled "The Agricultural Engineer," with the subtitle "A New Profession to Assist Those Engaged in Commercial Agricuture," which appeared in the November 14, 1923, issue of "Commerce and Finance." The article discusses in a very able way the need of agricultural engineering consulting service, qualifications needed, relation of consulting service to management, what the agricultural engineer does, and who needs such service. The publication in which Mr. Morse's article appears is published by Theodore H. Price Publishing Corporation, 16 Exchange Place, New York City.

E. Ruger Wiggins is now agricultural engineering editor of "Better Farming," published at Chicago. He was previously associated as agricultural engineer with the Western Advertising Agency, Racine, Wisconsin.

New Members of the Society

D. W. Bloodgood, U. S. irrigation engineer and head of irrigation department and irrigation engineer for New Mexico agricultural experiment station, P. O. Box 108, State College, New Mexico.

Transfer of Grade

Carl David Gross, teaching fellow, department of agricultural engineering, Iowa State College, Ames, Iowa.

Applicants for Membership

The following is a list of applicants for membership received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to applicants for the consideration of the Council prior to election.

C. P. Johnson, professor of rural engineering, College of Agriculture, Los Banos, Philippine Islands.

(Miss) Mary E. Keown, assistant secretary of trade association, director educational department, American Washing Machine Manufacturers Association, 10 S. La Salle Street, Chicago, Illinois.

Roger Dearborn Marsden, senior drainage engineer, U. S. Department of Agriculture, 6105 Broad Branch Road, Chevy Chase, Maryland.

John K. Pike, electrical engineer, General Electric Company, Schenectady, New York.

S. E. Reynolds, research branch, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S. W. 1, England.

Directory of Professional Agricultural Engineers

CLARK E. JACOBY ENGINEERING COMPANY
Consulting Engineers
Drainage, Land Reclamation, River and Flood Control, Tiling, Topographic Surveys, Bridges and Reinforced Concrete Structures
Interstate Building, Kansas City, Missouri

STANLEY F. MORSE
Mem. A. S. A. E. Consulting Agricultural Engineer
GEO. M. ROMMEL, Consulting Livestock Specialist
E. W. MITCHELL, Consulting Horticulturist
Farm inspections, plans, supervision
MORSE AGRICULTURAL SERVICE
132 Frant St., New York City

HARVEY R. BURR
Consulting Agricultural Engineer
Formerly director of agriculture at Williamson Trade School, Pennsylvania
Landscape Gardening—Farm Buildings—Canning Factories
Soils—Livestock—Farm Machinery—Water Power
Marketing—Farm Management
Waunakee, Dane County, Wisconsin

KURT GRUNWALD
Consulting Agricultural Engineer
Investigations and reports covering crop adaptability in arid and humid regions, potential sugar beet production, irrigation and drainage problems, appraisals on land, supervision of farms and ranches, and selection of livestock breeds.
Medford, Long Island, New York

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks, and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA104

AGRICULTURAL ENGINEER, student for four years at Institute of Civil Engineers, Moscow, Russia, and graduate of the Engineering Faculty of Petrowska Agricultural Academy, Moscow, wants position in irrigation work either in connection with surveys and projects or building irrigation works. Previous experience: Survey and hydrometrical measurements of rivers in Russia, occupying positions up to chief survey; organization for irrigation of Turkestan; during World War worked with engineering corps building bridges and roads, occupying position of assistant to chief of district; public service with water department of the Ministry of Agriculture of Bulgaria, including surveys of rivers and survey of irrigation and utilization of water power; instructor of surveying section of vocational school at Y. M. C. A., Sofia, at the same time giving lectures on agricultural machines and implements to chauffeurs and instructors at the tractor school. Age 34 years. Is now permanently located in United States. MA-120.